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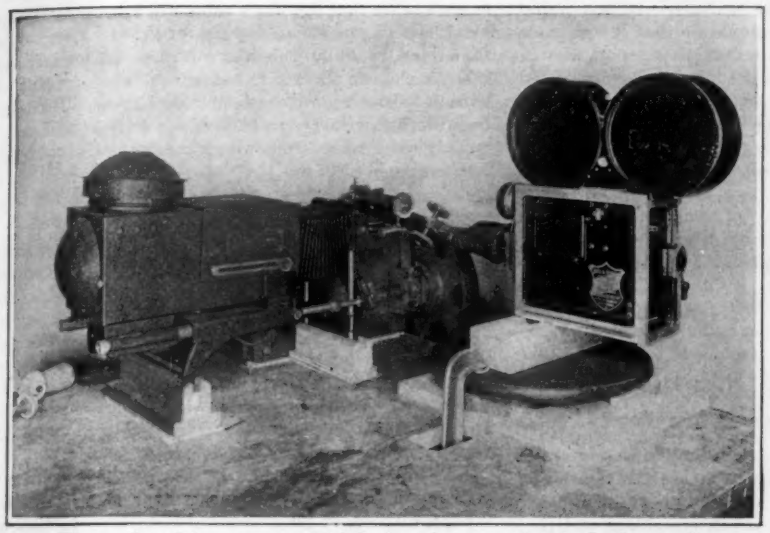
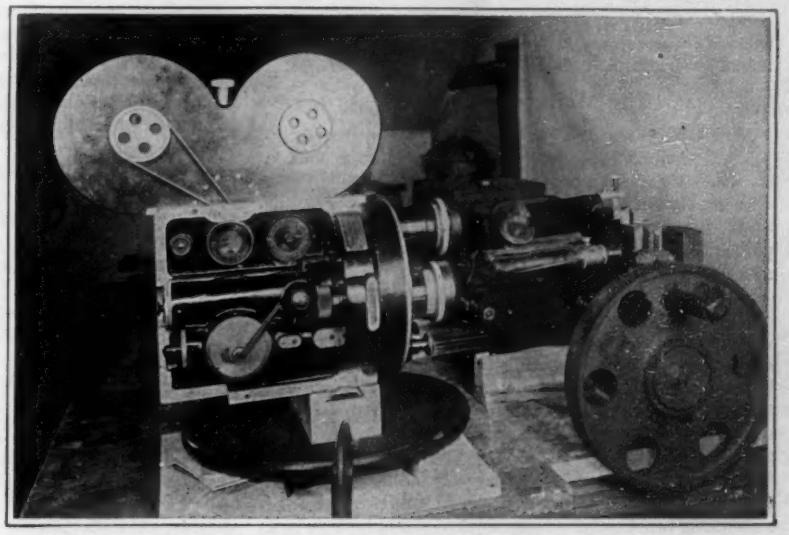


The motion picture camera (right), the microscope (center background) and the nitrogen illuminator (left)



The apparatus for motion picture tests of metal stresses. The same set-up as that shown at the left, but seen from the other side

Motion Pictures of Metal Stresses

THE moving picture has entered a new field. When it was first introduced few, if any, would have imagined that it would ever be applied microscopically—that is, that moving microscopic images would be taken or the revelation appear on the screen of what takes place under a microscope. What probably is the first instance of this kind was exhibited at a recent convention of testing engineers at Atlantic City, N. J.

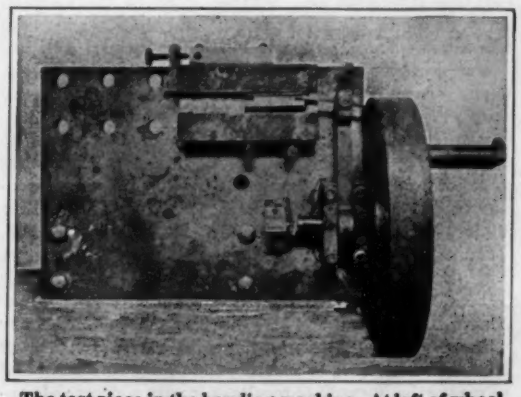
Wrought iron was used to try out the idea. It is known, that, when a metal like wrought iron or steel is subjected to alternate stresses or shocks brought about by repeated bendings or blows, the metal gradually deteriorates or weakens, and finally breaks, sometimes with serious consequences. It is also known that all such metal is made up of closely-lying crystals and that such bending or blows distort those crystals, causing the ultimate weakness.

A moving reproduction has been taken and vividly projected on the screen of the successive changes which take place in the structure of crystals of such iron when subjected to alternate bends or blows. The piece of iron was placed in a bending machine. The microscope was attached to just over the place or point where the iron was most affected and a moving camera was attached to the microscope. As the piece of iron was bent back and forth the effect in the breaking point was recorded through the microscope and in the camera. About one three-hundredth of a square inch of area of this iron was thus reproduced. The effect was remarkable, each minute change in the structure and crystals being accurately reproduced until the piece broke. The gradual progression or formation of the cracks or weakening lines was distinctly visible.

Credit for this really wonderful accomplishment is due to a professor in the University of Illinois. He has probably rendered a distinct service and may have opened up a broader field than he now realizes. He has probably introduced a method of investigation of far reaching importance, both technically and practically. It is believed that the new idea will be successfully applied to steel, non-ferrous or copper metals and other alloys in the near future. Besides explaining many interesting phenomena not now fully understood it may settle some controversies which otherwise would remain open much longer. It may determine just how steel as well as iron really deteriorates or weakens under stress, whether through the crystal or in some other way. Such an investigation might lead to a heat treatment prolonging the life of certain steels and making them less liable to fatigue, as it is called, or to gradual or sudden deterioration. The conclusion is evident that such an accomplishment might assist in prolonging the life of important members, cables and ropes for elevators, etc., conserving life and material as well.

By its application it may ultimately be possible to tell, for example, by the appearance of the surface under a microscope, whether a material has passed 30 per cent of its effective life or 90 per cent thereof. If the characteristics are sufficiently pronounced, which experience alone can tell, then it will be possible to polish a section of a cable in use and examine it with a microscope from time to time and thus determine whether that section at least is nearly ready to fail or whether it shows no indication of failure. These observations would be based on previous moving pictures of the same material. The keynote of the idea is that failure takes place gradually, beginning the moment a piece of metal is first put into use, and ending only when that piece gives way entirely.

A motion picture view of an unstressed sheet of metal



The test piece in the bending machine. At left of wheel and in front of metal sheet is seen the counter which records the number of stresses delivered

An exposure showing the fissures that existed after 424 flexures

Nature of Rice Polish and Its Use

RICE polish is a comparatively new cereal substitute, being the waste which comes from the rice in the polishing process whereby the outer layers of the grain, containing phosphorus, are removed. Formerly this rice polish was sold by the ton for stock food, but an agent of the United States Department of Agriculture, visiting New Orleans, had it placed on the market for making conservation bread in proportions of one-fourth rice polish to three-fourths wheat flour.

The Flour and Grain World describes the methods of cleaning and polishing rice whereby this product is obtained. Rough rice from the threshing machine is first separated from trash, the hulls or chaff removed by rapidly revolving millstones, and the outer skin of the grain then removed by pounding in huge mortars, which gives a mixture of clean rice, fine chaff, and flour. The rice is then polished by friction against moose hide or sheepskin, tanned and worked to a high degree of softness, by which the outer layers of the grain are removed. This is the process that yields the rice polish, which is said to contain the most nutritive portions of the grain.

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

The Majesty of the Law

A FEW years ago, as the result of a carefully-planned conspiracy by a set of desperadoes, a citizen was murdered on the streets of New York. Due largely to the energy of the present Governor of this State, the five culprits, including a member of the city police force, were arrested, tried, condemned to death, and duly executed.

The vast enginery of the forces of law and order of the city and state were set in motion, not because the murdered man was a citizen of any distinction (as a matter of fact he was an obscure member of the underworld); but because the law for the protection of human life having been broken and a life deliberately destroyed, it was necessary for the future protection of human life that the law against the taking of life be vindicated. Those four young men and that police officer were put to death, not in any spirit of revenge, but rather by the automatic functioning of certain inviolable laws, which are the outgrowth of the agelong struggle of man to make this world of ours a safe place to live in.

Through four long years of agony, civilization has been called upon to witness, upon a worldwide scale, a repetition, in its salient outlines, of that sordid and brutal slaying which has passed into history as the Becker case. Substitute for that one murdered citizen ten millions of the very flower of the young manhood of the world, substitute for the infamous Becker and his accomplices the ruling caste of Germany and Austria, who conceived and set afoot this conspiracy of murder and loot—and the parallel is complete.

Becker, masquerading in a uniform which proclaimed him to be a guardian of the peace and security of the citizens, gathered his agents together and sent them to slay a man, whose removal would guarantee his own prospects of greater loot from the gambling houses that he had taken under his wing.

The military master of Germany, while parading as the guardian of the peace of Europe, gathered together the men and the means for a war that should bring untold wealth to him and his people; and, when the time was ripe, he launched his marauding armies upon a peaceful and unsuspecting world.

For the vindication of the law in the case of the deliberate murder of one man, civilization, as represented by the City of New York, sent five men to the chair.

For the vindication of the law in the case of the deliberate murder of ten million men, what is the duty of civilization, as represented by that stricken world, for which our President is today the spokesman?

This is a question, the first whisperings of which are already audible—a question which is destined to thrust itself into the very forefront, as this awful tragedy moves on to its close.

Fiat justicia, ruat coelum, said those great jurists, the Romans of two thousand years ago: "Let justice prevail, though the heavens fall." Is mitigation for crime to be found in its very magnitude? Shall the man who slays his fellow die, and the man who slays him by the million live?

But who shall be the judges and what the code of laws by which the perpetrators of this world-butchery shall be tried?

Well, the leading nations are more or less committed to the proposal for forming an international court, which hereafter shall substitute the arbitrament of the law for the arbitrament of war.

What more fitting prelude could there be to the formation of such a court, than the selection of a chief justice from each of the nations of the Entente, and the formal trial, by the due processes of criminal procedure, of those leaders in Germany and Austria, who hatched this conspiracy and let loose this welter of rapine and murder?

Let these men be represented by the ablest legal talent of their respective countries; and let the trial be conducted with all that meticulous care which marks the course of criminal procedure in the courts of the civilized world.

Let the accused men take the stand and testify, if they will, in their own behalf. Let the original State records be produced, and notably those, if such there be, which will prove that Germany moved Heaven and Earth to hold back Austria from her mad insistance. Let von Hollweg swear that he never in the Reichstag admitted that the invasion of Belgium was a moral outrage. Let von Jagow bring proof that he never referred to a German-signed treaty for the protection of Belgium as "a scrap of paper." Let von Tirpitz swear that he never sent his U-boats forth to do wholesale murder upon the high seas, and let him produce documentary evidence that the "Lusitania" was an armed cruiser, and therefore a vessel of war. Let the military records be brought forth to disprove the judicial murder of Nurse Cavell, Captain Fryatt, and a hundred others.

And if it be objected that this would be a prejudiced proceeding, since no German or Austrian judge would sit on the bench, the answer would be that it was made so by the deliberate act of the accused themselves, who, in their international relations, had long ago disavowed the accepted laws of civilization, and substituted therefor a code of military expediency, brute force, and unbridled cruelty.

If the military masters of Germany, from Kaiser down, should be found guilty in the first degree, it is conceivable that the majesty of the law having been vindicated, the extreme penalty might be commuted, as a concession to the sentimentalists, to one of imprisonment for life.

But above all things: *Fiat justicia, ruat coelum.* And let it thus be recorded once again, and for the warning of all ages and peoples to come, that "They that take the sword, shall perish by the sword."

Is the German Army Crumbling?

NOTHING would please the military masters of Germany better than to create the impression among the civilian population of the Entente nations, that the German army is crumbling and that peace will come before Christmas. Staggering under the weight and borne back by the pressure of the Entente attack, the fighting qualities of her troops and the genius of her generals are being strained to the breaking point, no doubt, in the effort to carry through successfully that most difficult of all military maneuvers, a general retreat in the face of, and in close contact with, superior and victorious forces of the enemy.

The object of the German High Command is to withdraw its armies, practically intact, to the line of permanent defenses along the frontiers of Germany, before the rains and snow of winter call a halt upon military operations. They realize that the consequent shortening of their line would automatically release from thirty to forty divisions to form a reserve, of which just now they seem to have next to nothing.

This retirement is now in full flood; and, thanks to that infernal weapon of the defense, the machine gun, they seem during the past few days to have been able to delay the pursuing armies sufficiently to withdraw the bulk of their artillery beyond range of capture.

However much we may loathe and despise an enemy who has shown himself to be brutal and bestial beyond all belief, let us not fall into the fatal error of underrating his military capacity. There is all the difference in the world between a carefully planned and orderly retreat and a rout. The strategy of Marshal Foch and the valor of the Entente armies have forced the greatest military force the world ever saw into a general retreat—it is now for the genius of Foch and the superb dash and endurance of his armies to turn that retreat, if possible, into a rout.

The peril to the Allied cause, just now, is that we are in danger of mistaking the one for the other. The German armies are not routed; and the way they respond when called upon to hold by counter attacks such portions of the line as are essential to the orderly retirement of the whole front, proves to the military mind that the discipline and fighting spirit of the German army as a whole are still intact, and that it may take a season's campaign to bring about a general collapse.

Nor must we let ourselves be mislead by the present bogus peace talk from Berlin. This war maneuver coupled with a foolish super-optimism of the "peace by Christmas" kind, distinctly served to dampen the enthusiasm for the Fourth Liberty Loan. The soldiers at the front know better; and in this connection we cannot do better than quote from the letter of a British Major, attached to the French Headquarter's Staff, which was published in the New York *Times* of October 13th. Speaking of the exaggerated optimism noticeable in certain of our papers he writes: "I see by some of the American papers that you sent me that there is a tendency natural, perhaps, after the appalling strain and danger of March and April, to magnify the present offensive and to regard the immediate results of it with a degree of confidence which, to those who know what yet remains to be done, is false and likely to cause a disastrous slackening of effort in all the work behind the lines.

"They use the word 'cracking' about the Huns. They write jubilantly of their broken morale, the destruction of their reserves, and the fact that they are now fighting only because they are driven to it by their officers. All that sort of stuff makes us sick, and if a mere glance were given to the casualties of the British army alone, it would be seen that the Germans are putting up the fight of their lives. It is a back-hand blow in the face to us, the French, the Americans, and the Belgians, to read that we are all spanking a lot of cowed and frightened men who spend their time in throwing up their hands and blubbering 'kamerad,' when the truth is that every inch of the ground we retake is soaked again by our blood and only comes back to us by hard and incessant fighting against a huge machine of clever, desperately courageous men, masters of every conceivable trick and damnable device.

"Is it insanity or pro-Germanism that makes men say to each other that the whole show will be over by Christmas? Can't you do something, or get the *Times* to do something, to stamp this idea out of people's minds and make it clear to them that so far from it being nearly all over bar shouting, we are something like six times as far from Berlin as the Germans are from Paris?"

This is the voice of one who is in the thick of the fight. Let us give heed to it.

Hindenburg's Dilemma

IF it were possible, Aladdin's lamp in hand, to journey to the headquarters of the German Great General Staff, and sit, unseen, at the table around which the men who control the German armies are accustomed to gather these days, it would be found that there is one absorbing subject of debate occupying the minds of Germany's military leaders. The problem now pressing for solution is that of withdrawing the German armies from occupied territory, and reorganizing them behind the fortifications of the German frontier.

The orderly withdrawal of armies, totaling many millions of men, and millions of tons of supplies and equipment, would be a colossal task, even in time of peace and with no enemy in the field. To execute such a withdrawal in the face of an enemy who is superior both in numbers and morale, is a task so stupendous, that it is causing many a resolute jaw to drop, around that council table, and many a cruel face to blanch.

For the glorious fighting men of Belgium, Britain, France, Italy, and America, as these baffled strategists know too well, are not merely "in touch" with their retreating armies, but have them in a mighty grip, and have bitten into them with a hold so deep and sure, that, squirm and struggle as they will, the Teuton hosts are unable to shake themselves loose. And so these men find themselves confronted with the colossal task of fighting with one hand a delaying action, on a front hundreds of miles in length, and against an enemy flushed with unbroken success, while with the other hand they endeavor to disassemble and transport to the German frontier in a few weeks' time a vast assemblage of heavy and light artillery, huge accumulations of shells, powder, and high explosives, and the contents of great depots crammed with food, clothing and general military supplies. And these swollen accumulations of four years of war have to be moved to the rear over railways and roads, that are all too few for the heavy duty thus suddenly thrown upon them and that are torn open by the bombs and sprayed by the machine-gun fire of an overwhelming force of bombing and fighting airplanes.

Gone forever from the Great General Staff is any dream of regaining the initiative on foreign soil, or even on their own. The hypocritical lie with which this band of organized bandits threw themselves upon a peaceful Europe has been transformed by the valor of civilization into a frightful truth. For Germany is now, in very truth, fighting a defensive war; fighting it with the desperate courage of a robber band about which the sheriff's posse is closing in for the final capture.

There was no moral appreciation of the mercy and righteousness of peace, nor the faintest touch of sincere repentance, in the alacrity with which the Great General Staff brought forth from its pigeon hole our President's "fourteen terms" (kept them for the present emergency), and with unctuous lip-service pronounced themselves ready to withdraw from all occupied territory.

Of course they are ready to withdraw, and the measure of their readiness is to be found in the magnitude of the military failure involved in their acceptance of the terms of the President's note. That this readiness is the exact measure of their self-confessed military failure, is proved by the fact that never in all the history of war has there been a case where an army of several million men, far advanced into enemy territory, possessing unobstructed communications with its base of supply, has suddenly agreed to retire from hard-won territory and lose all that bitter fighting had gained.

The political retreat has failed to get the enemy safely back to his frontiers. Will the military retreat under Hindenburg fare better?

Naval and Military

German Poison Gas in 1908.—Prof. Richard Norton, who organized the American Volunteer Motor Ambulance Corps, and whose death in Paris has been recently announced, disclosed the fact during the Champagne battle in October, 1915, that the German gas apparatus captured at that time dated as far back as 1908. Evidently these delectable people were at work on their barbarous devices six long years before the war broke out.

First "Eagle" Boat Tested.—The Secretary of the Navy announces that the first of the much-talked-of Eagle boats, which Henry Ford was to have turned out at such amazing speed, has been tested and that from now on the boats will begin to take to the water in quantities, or words to that effect. Judging from the fact that the lines of these boats were drawn with a view to a minimum of bending and shaping during the construction of the vessels, we confess to amazement that the first of the craft has only recently been tested, and that quantity production is only now possible.

Guns and Shells for 1918.—During a recent address, Winston S. Churchill, Minister of Munitions, told the British people that although the output of shells in their munitions plants is now 12,000 tons daily, they must increase their output for 1919, in order to supply a portion of the armament and equipment for the American forces. He reminded his hearers that the Americans are sending men to Europe far in advance of their original program and in advance also of the development of their own great munitions program. Great Britain, he stated, had undertaken to supply many hundreds of guns of different calibre, including some of the most important types, to the American army.

British Shipping Losses During the War.—During his recent visit to this country Sir Eric Geddes, First Lord of the British Admiralty, made some important announcements on topics which have hitherto been closed by the censor. In reviewing the British effort, Sir Eric said that this year British casualties on the western front had equalled those of all the Allies combined. The British navy since the beginning of the war has lost 230 fighting ships, more than twice the losses in war vessels of all the Allies. In addition, she has lost 450 auxiliary craft. From the merchant marine, said Sir Eric, they had lost 2,400 ships, representing a gross tonnage of 7,750,000, which is nearly three times the aggregate loss of Great Britain's Allies.

Electric Welding and Cargo Capacity.—The Electric Welding Committee of the United States Shipping Board, speaking of the economic saving due to electric welding, refers to the fact that in a 5,000-ton ship about 450,000 rivets are used, and about 650,000 in a ship of 9,500 tons deadweight. The saving on the hull-plating and other vital parts in labor, cost, and time of construction, due to the substitution of welding for riveting, is conservatively placed at 25 per cent. The saving of labor on the minor parts of the ship is estimated to be from 60 to 70 per cent. There is also a considerable saving in weight, which is estimated to be about 500 tons on the hull of a 9,500-ton ship. This, of course, would mean that the ship could carry 500 tons more cargo.

Keep the Lower Ports and Portholes Closed.—The recent sinking of the troopship "America" at her dock in this city, following at an interval of a few months, the sinking of the "St. Paul" at her dock, reminds us that constant care should be exercised to see that the lower ports and portholes are closed while a ship is loading and adding to her draft. We do not know whether open ports were responsible for either sinking; but they may well have been. Except when it is absolutely necessary, the lowest line of portlights and loading ports should be kept closed whether a ship is in harbor or at sea. So important is this matter, that the International Board which sat in London after the "Titanic" disaster made a special stipulation, that the lowest line of port openings through the shell of a ship should be a minimum number of feet above the deep loadline.

Two More Vessels for the Shipping Board.—The great Newark Bay shipyard set afloat on October 14th two more of the fleet of steel cargo boats which they are building for the United States Shipping Board. The names of these vessels are the "Allies" and the "Consort." This yard, the second in size among the new plants laid down for the construction of ships for the Shipping Board, has 28 building ways, all of which are occupied by steel vessels of 5,500 tons deadweight capacity in various stages of completion. The Submarine Boat Corporation has a contract to build 150 identical ships. The length of the vessels is 343 feet on deck, the moulded breadth is 46 feet, and the moulded depth of the hull is 28 feet 6 inches. They are driven by a Westinghouse steam turbine, operating at 3,600 revolutions per minute, which drives the single screw propeller at 90 revolutions per minute through Westinghouse reduction gear. The speed of the vessels at sea, fully loaded to a draft of about 23 feet, is expected to be at least 10½ knots per hour.

Science

Lectures on Aeronautics.—In accordance with arrangements made by the Aeronautical Society of Great Britain, members of the staff of the National Physical Laboratory have been giving a series of lectures on aeronautics at various centers throughout England chiefly for the purpose of stimulating interest in this subject among persons engaged in aircraft production.

Investigations of Wheat Substitutes were carried on by the U. S. Bureau of Chemistry long before the present food crisis, and the results of several years' experiments were available when the war broke out. The Bureau's laboratory of plant chemistry has investigated about 30 substitute flours. Investigations are now in progress concerning the keeping qualities of these substitutes.

Wearing Tests of Shoe Leather.—The leather and paper laboratory of the U. S. Bureau of Chemistry has undertaken for the War Department some tests of shoe leather, the results of which will be of interest to the public at large as well as to the Army. From 1,000 to 1,500 pairs of shoes, made with several different kinds of sole leather substitutes, and uppers, will be distributed to a corresponding number of soldiers, and careful records will be maintained of their service over a period of six months.

Medical and Agricultural Schools in West Africa.—The American consul at Dakar, Senegal, reports that the French authorities have just established at that place a medical school and a school of agriculture, both for the education of natives. The immediate occasion of this step is the return from the front of thousands of natives, wounded or in poor health, who require more adequate facilities for medical treatment than are now available, and, as to the medical school, the expectation of economic expansion following the war.

Aeronautical Abstracts.—Arrangements have recently been made in Great Britain for continuing the valuable series of abstracts of technical papers relating to aeronautics, formerly published in the Technical Reports of the Advisory Committee for Aeronautics. This work has been taken over by the National Physical Laboratory, the Aeronautical Society of Great Britain and the Intelligence Department of the War Office. This Department will print and circulate the abstracts and they will probably also be published in the *Aeronautical Journal*.

Red Cross Tuberculosis Unit in Italy.—The American Red Cross has just appointed a medical unit to conduct a campaign against tuberculosis in Italy. The undertaking is similar to the one which the Red Cross has had on foot for some time in France, and is for the benefit of the civilian population, whose health requirements have necessarily been somewhat neglected, owing to the absorption of Italy's resources in war work. The staff of the new unit numbers 60, and includes some of the leading tubercular specialists of this country. It is directed by Dr. W. C. White, of Pittsburgh.

Stagger Grass.—Bulletin 710 of the U. S. Department of Agriculture describes feeding experiments which prove the extremely toxic character of *Chrosperma muscætoxicum*, also known as *Amianthium muscætoxicum*, and popularly as "stagger grass," "fly poison," "crow poison," or "fall poison." Although hitherto recognized as poisonous and used sometimes as an insecticide, this species had not previously been reported as a stock-poisoning plant. The experiments indicate that it is probably much more poisonous than *Zygadenus*, which causes heavy losses of sheep in the West, and it is believed that most animals are susceptible to its effects. The plant occurs over a wide extent of the eastern United States, from Long Island to Florida, and west to Arkansas. It grows from a coated bulb. The leaves are narrow and grass-like, those of the stem being few and short; the stem is much longer than the leaves, and bears a dense raceme of flowers, which turn greenish with age. The fruit is red.

Applied Science in Great Britain.—A description in Commerce Reports of the British Scientific Products Exhibition, held in London from August 16th to Sept. 7th, furnishes striking evidence of the progress made by British scientific and technical industries in occupying fields of production hitherto largely monopolized by Germany. The development of the British dye industry was illustrated by a large collection of samples of coal tar derivatives. The exhibits also included analytical laboratory reagents that have satisfactorily replaced those furnished by Germany before the war. England now produces thymol, aspirin, atropine, salicylic acid, and many other important chemical products formerly obtained from Germany. Other new and successful British products include hard porcelain, magnetos for motor-cars and airplanes, optical and chemical glass of high quality, paper wearing apparel and containers, etc. Among the many surgical and medical appliances exhibited were artificial eyes now manufactured on a large scale in Birmingham, and said to be far superior to those produced on the Continent.

Electricity

Long-Distance Transmission in Germany.—It is announced that the work of erecting a transmission line between Golpa (Prussian Saxony) and Berlin has been completed. The distance is 132 km. (about 82 miles) and the maximum tension 100,000 volts. The conductor is of aluminum, and it is stated that it will save the transport to Berlin of 120,000 to 150,000 tons of pit-coal annually.

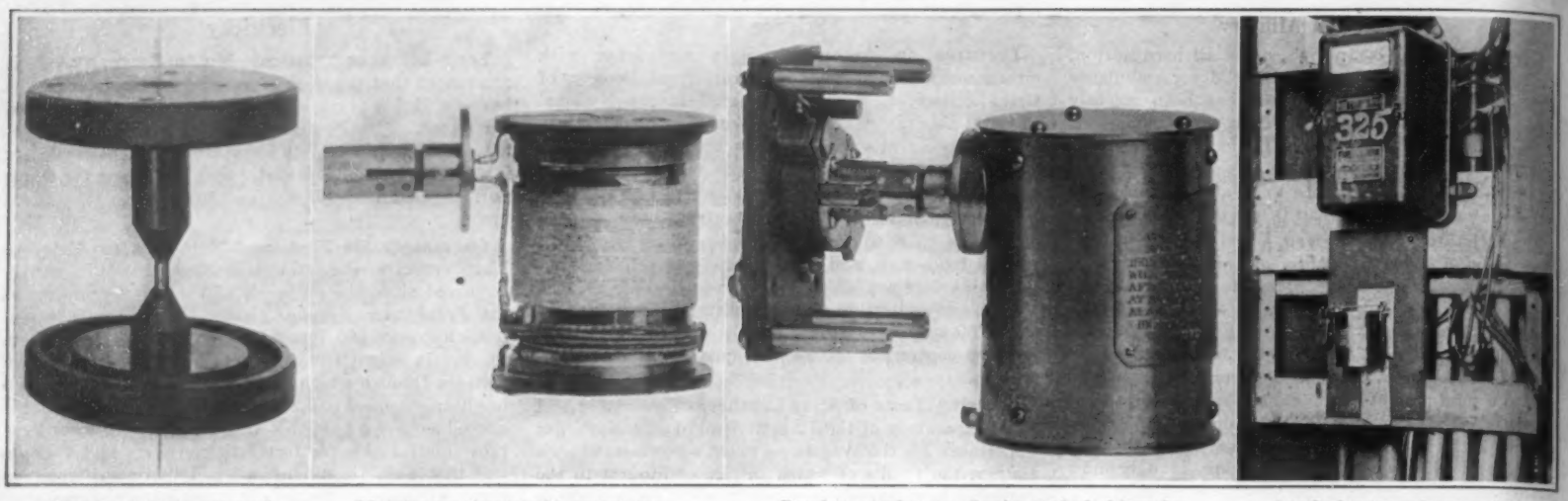
Germany's Six-Thousand-Mile Wireless Voice.—The German wireless station at Nauen has been greatly improved since the outbreak of the war, according to the *Frankfurter Zeitung*. Instead of a single transmission tower 300 feet high, it now has ten towers ranging in height from 890 feet to 360 feet, while the distance through which the messages can be transmitted has been extended to 6,200 miles. The German paper is quoted as saying that the Nauen station's services have proved invaluable for instructing cruisers and U-boats and that both the "Goeben" and "Breslau" received through Nauen instructions to steam into the Bosphorus.

Researches on Weston Cells.—A publication issued by the Electrotechnical Laboratory of the Department of Communications, Tokyo, contains a report by Mr. J. Obata on Weston standard cells exchanged with the Bureau of Standards and the National Physical Laboratory (in whose recent annual report a reference to the matter was also made). Since the initiation of the work of the laboratory in Japan, about seven years ago, more than 200 Weston cells have been set up and tested, and certain selected cells, used as standards of reference, show very slight variations indeed. The method of preparation of the cells is described and the results of several series of comparative tests summarized. It is concluded that the standard of E. M. F. in use in Japan agrees very closely, probably within one part in 100,000, with those of the American and British national laboratories.

A New Japanese Long-Distance Station.—The installation of a new high-power wireless system between Japan and the United States is actively engaging the Japanese department of communications. Officials announce that the project is a result in part of the very great congestion and delay in cable transmission which prevents the desired freedom of communication between Japan and the United States. The Japanese high power station, continues *Wireless Age*, communicated direct with the Marconi station in Hawaii. The proposed station will work with a station on the Pacific coast, the site of which probably will be near San Francisco, a distance of 4,600 miles. This will be one of the longest direct wireless services in the world. The estimated cost of a new wireless system is about $400,000. While another cable linking the two hemispheres is desired, a line from Japan to Guam alone would cost $3,000,000. It is expected that details of the new wireless project will be announced shortly.

Micanite Insulation for Commutators.—The insulation of commutators has been given study since these became an integral part of electrical machinery. Soon after difficulties developed with the makeshift insulation used at first, reliance was placed on mica, but various experiences were met with due to difficulties in selecting the proper grade of mica and of handling it effectively so as to form proper insulation between commutator bars. About 1892 micanite was placed on the market to overcome the difficulties formerly met with in handling natural mica. Micanite is carefully selected amber mica which is subdivided so that it constitutes films of minute thickness which are then reassembled into a consistent whole. These thin films are fastened together by insulating cement by the application of heat and pressure. The micanite plates are large sized sheets of relaminated, super-imposed layers of thin split mica sheets, the average area of which is at least three square inches, concludes *Electrical Review*.

An Illuminated Fuse Tester.—Unless some form of fuse tester is available, it is at present common practice to replace with new fuses all the fuses of a cut-out box in which one fuse has blown, waiting for a further opportunity to make a test to detect the blown fuse or fuses, and to replace in stock the fuses which have not operated. Not only does this method consume unnecessary time, but it requires a stock of fuses fully double that which should answer the purpose where tests for operative fuses are made at the cut-out boxes. It has remained for Mr. R. S. Blake of Chicago, Ill., to introduce an appliance which does away with wasted time and wasted money in discovering a blown fuse. Essentially, his appliance consists of a fuse tester and a pocket flashlight. The tester is held in one hand, the light flashed on, and the necessary contacts are made by means of the two contact points—one a stiff, heavy, rubber-insulated wire, and the other a rubber-insulated, flexible wire. The result of the test is immediately apparent by the lights, which either flash on or remain dark. The two test lamps, which can be changed for any voltage, are arranged in series. This device, it is evident, can be employed in the darkest corners, where panel boxes are generally located.



Arrangement of the measured copper anode | Metering can element with contact arm, ready for container | Complete metering can, showing method of inserting in a supply circuit | Standard meter and new metering can installed

Features of the recently developed metering can which may soon take the place of the conventional watt-meter for small current consumers

Selling Electric Service By the Can

IT may be that in the near future electric service will no longer be measured by the conventional meter, and that meter readers and monthly bills and extensive bookkeeping systems will have become only reminiscences of past days of inefficiency. For there is in existence today a device, known as a metering can, which places the business of selling electric current on the same basis as the retail store; it makes possible the selling of specified amounts of electric service in cans, which are purchased and paid for in advance by the consumer, as required. These cans guarantee a certain amount of electricity over any period, give warning when the quota has been exhausted, and then automatically discontinue the service.

The electrolytic metering can has been developed by Mr. E. O. Schweitzer of Chicago, Ill., to take the place of the direct-current recording meter for small consumers, with the main object of eliminating the expense of reading the meter and calculating the bill at monthly intervals. This automatic electrolytic meter is regarded as distinct from any other electrolytic meter so far proposed. There are no deposits to be weighed, no delicate balances to be maintained, and no moving mechanical parts to be adjusted. The electrolytic action upon which its operation is based is far more sensitive and accurate than that of meters hitherto employed, because of the design of the electrolytic elements, and partly because the regulating resistance units are so designed as to minimise the effect of resistance variations in the electrolytic cell.

The device is designed automatically to open the circuit and terminate the supply of electric service to the consumer as soon as he has completely used a specified amount of current for which he has paid. The measurement of current depends upon the electrolytic action of a small shunt current acting on the anode, a small copper cylinder of known weight, which is gradually consumed by this action during such time as current is being used, but is unaffected during the time when no current is being used. The ratio between the shunt current and the weight of the copper anode is such that the latter is completely consumed when the specified amount of current has been used. The final disappearance of the anode opens the main circuit, and terminates the service.

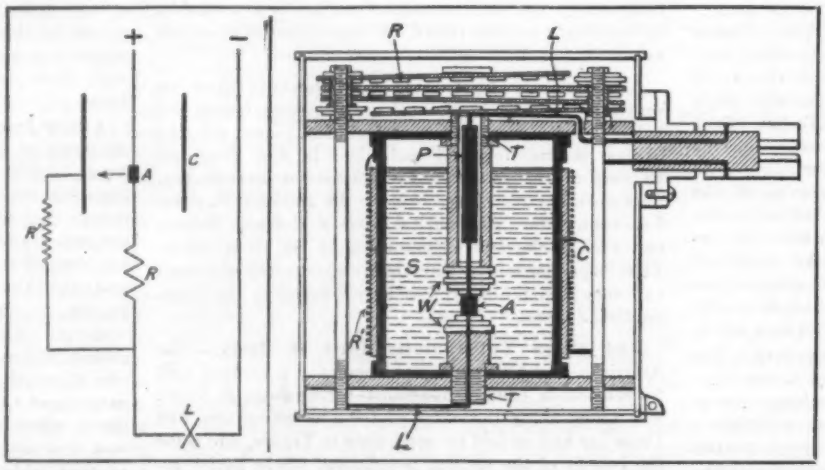
By referring to the first sketch or wiring diagram, the electrical operation of the device can be readily understood. The polarity of the terminals is indicated. The shunt current flows from the anode as indicated by the arrow through the copper sulfate solution to the walls of the cell *C*, which also acts as the containing vessel for the solution. The weight of copper dissolved from the anode by electrolytic action is directly proportional to the value of the shunt current, depending upon a definitely known relationship. The total resistance of the shunt circuit is about 300 ohms, the sum of 280 ohms constant resistance at *R'* and about 20 ohms resistance in the solution and at points in contact between solution and electrodes (anode and cell walls). Since the resistance at *R* is 0.3 ohm the shunt current will always be one-thousandth part of whatever current may be flowing through the main circuit, subject to certain variations. The weight of copper dissolved from the anode thus bears a definite relationship to the ampere-hours which may be used by the consumer before his service is automatically cut off by the dissolution of the anode.

The construction of the cell in cross-section appears in the second drawing, for which we are indebted to *The Electrician*. It will be noted that as soon as the main circuit is broken by the complete dissolution of the anode the main or load current crosses the gap through the solution which now forms the only connection between the ends of the copper leads, which formerly made contact with the anode. The upper or positive end is rapidly eaten away and the copper is deposited on the lower end. At the same time there is a considerable voltage drop between the ends, since the resistance of the solution is relatively high, and a rapid generation of heat takes place. As soon as the temperature becomes sufficiently high the 60-degree solder melts, releasing the copper cylinder *P*, which, no longer supported by the anode below, drops, and completely opens the circuit at a point above the level of the solution.

This cycle of operations has a characteristic effect on the consumer's lamps or other current-consuming equipment. At the moment when the metallic circuit is broken the current is shut off completely for a fraction of a minute, extinguishing the lights. Then, as current begins to flow through the solution, the lamps will light up with a flickering, uncertain light, which varies in brilliancy according to the total wattage of the lamps in service. This continues until the permanent cut-out occurs, and the service is completely interrupted.

In the photographic illustrations are depicted the parts of the metering can, the method of inserting the can in the service lines, and a standard meter and a metering can installed to show the difference in size. The metering can is so constructed and enclosed in a brass case that it cannot be tampered with, nor be deranged by accident. It is provided with a contact arm which is inserted in the keyhole aperture of a contact box, given a slight twist to engage with the spring clips of the supply lines, and left until the specified amount of current has been consumed and the cell is exhausted.

The metering can is not limited to direct current. An almost identical arrangement in dimensions and circuits may be employed for alternating current work. When the metering can is so employed the container electrode is made of graphite impregnated with paraffine and the measured electrode is constructed of copper in a manner similar to that of the direct current meter. The electrolyte in both cases is a saturated solution of copper sulfate. In the alternating current cell it has been found desirable to omit the resistance in series with the measured electrode.



A.—Copper Anode. *C.*—Walls of the cell which serves as cathode or negative electrode in shunt circuit. *L.*—Variable load of the consumer's service. *R.*—Series resistance of 0.3 ohm. *R'.*—Shunt resistance of 280 ohms

A.—Copper anode. *C.*—Copper cylinder. *S.*—Copper sulphate solution. *TT.*—Protecting tubes of hard rubber. *LL.*—Copper leads forming part of main circuit, and making connections with the anode. *WW.*—Rubber washers. *P.*—Solid copper cylinder forming part of main circuit, and connected to copper lead at its upper terminal by means of special solder which melts at 60 deg. *R.*—Series resistance. *R'*—Shunt resistance

Diagram of connections and cross section of metering can

To Keep the Automobile Engine from Stalling

THE internal combustion engine is in many respects an advance; but in one it is just like every other engine. It does not create power out of nothing; it has a definite capacity. If we load it beyond that capacity, it will sputter in protest and stop—as the automobilist knows all too well.

A stalled engine is not so serious as a broken axle or a brake that fails; but it is enough of a nuisance to make its elimination welcome. Now if stalling is caused by overloading, the logical remedy would seem to be a device for automatically relieving the engine of its load before stoppage has become complete, allowing the engine to run idle until it has regained its breath. This might stop the car, to be sure; but if the engine stalls, the car stops anyhow, and the proposed remedy at least keeps the engine running. We illustrate the way in which an ingenious inventor, E. F. Murdock of New York, has worked the thing out.

The electric circuit by means of which the manipulation is effected is a rather complicated one. Starting from the battery, it runs to and through the crank-case. From here the current flows across the bearing surface between case and shaft, and via the crankshaft, and flywheel to the contact *A*. The latter is insulated from *B*, and *B* from the flywheel itself, by the V-shaped piece between *A* and *B*, which is shown open. Picturing this as closed, it will be realized that the flow is through *B* and to the ring mounted on the

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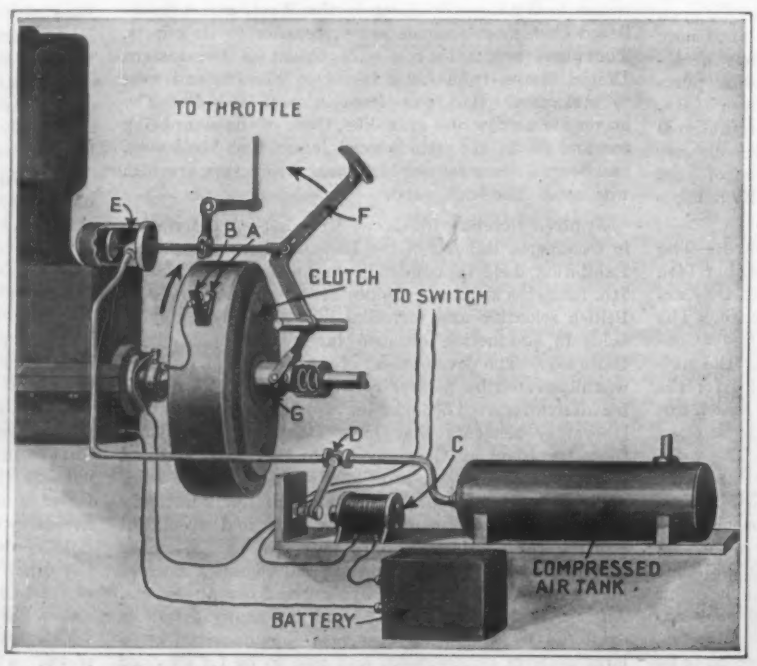
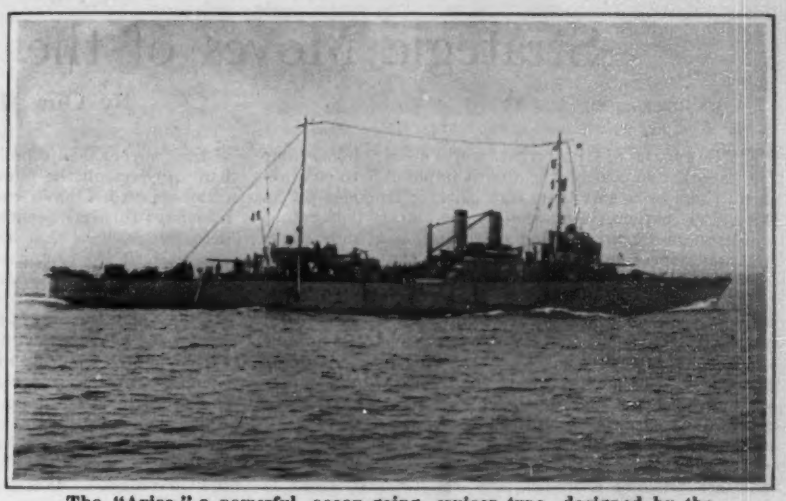


The regulator that disengages the clutch when the engine is about to stall

Any race but the Germans would have let alone the fisherman—the poor man of the sea. So the French have to convoy their fishing fleets. View taken from convoying craft



The "Aviso," a powerful, ocean-going, cruiser type, designed by the French specially for anti-U-boat operations. These craft have high freeboard, great speed and heavy armament

Anti-U-Boat Operations of the French Navy

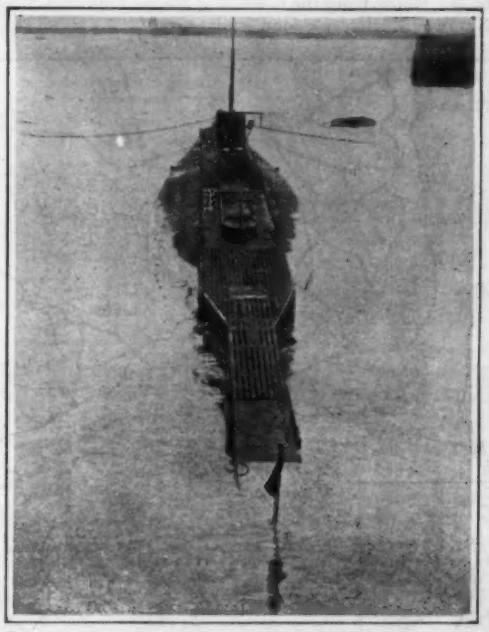
How the Sinister Piracy of the Hun Was Met and Mastered

THE submarine, since the outbreak of hostilities, has been a conspicuous weapon in the hands of the German naval commanders. Its importance as a decisive arm in modern naval warfare had been appreciated, however, many years before the present conflict, by certain French experts who, realizing that France could never hope to meet Germany on equal terms upon the sea, sought to counterbalance this inferiority by providing her navy with flotillas of submersibles in sufficient numbers to keep the hostile fleets from venturing too near to the strategic "Pas de Calais." But the great surprise of the first few months of the war was that the rôles of the two navies were reversed, and that it was the French who, contrary to expectations, found themselves placed on the defensive and obliged to parry the undersea thrusts of their bitterest foe.

Just how stupendous was the task that confronted the French Ministry of Marine in 1914, is revealed by the fact that no less than 2,500 guns and gun-mounts and 10,000 sailors have been required to arm defensively the seagoing vessels of the French merchant marine, not to speak of the armament required for the various types of patrol boats and chasers that, from time to time, have been placed in service.

On the outbreak of hostilities the French navy was concentrated in the Mediterranean Sea, where its specific duty was to contain the Austrian naval forces. This seemed a simple task for the French armada, which comprised 22 battleships, 19 armored cruisers, 12 light cruisers, 84 destroyers, 135 torpedo boats, and 78 submarines. But the presence of the German cruisers, "Goeben" and "Breslau" in the Dardanelles, and the unexpected appearance of commerce-raiding U-boats in the Adriatic, Mediterranean, and Aegean seas, not to mention their sudden incursions into the Bay of Biscay, Straits of Gibraltar, and visits off the coasts of Morocco, Senegal and Syria, soon brought calls for immediate relief and assistance from all parts of the coastline.

Unfortunately the French navy, at that moment, had neither the material nor the personnel to meet the emergency. The events on land, during the first six weeks of the war, had so completely subordinated the operations at sea that everything was sacrificed, everything had to be sacrificed, to snatch victory out of defeat. In the emergency, the navy was called upon to strip of guns not only its harbor defences, but also its ships; while 60,000 officers and seamen were transferred to the army to help stem the German invasion, and several of the navy yards were fitted out as temporary arsenals for the manufacture of munitions for the artillery at the front. The Ministry of Marine, in consequence, found itself compelled to fight an uphill battle against the greatest possible odds, in order to reach the point where it could



French submarine in the awash condition. U-boats are being successfully fought with submarines

undertake any offensive tactics against the German undersea pirates.

The types of vessels employed in the anti-submarine operations were those which were immediately available —tugs, trawlers, yachts, small motor boats—and were necessarily merely makeshifts intended for defensive operations only until better craft could be built on the already crowded ship-ways. But the fishermen of Britanny and Normandy were not slow to show what their little trawlers could do, even if they were inferior in speed and armament to the already formidable antagonists. A little later the appearance of a number of mine-laying submarines caused the French naval commanders to welcome the coöperation of another special class of converted vessel, the mine-sweeper, which, likewise manned by fishermen, has played a most important rôle in the present naval conflict.

The coöperation of aircraft in anti-submarine operations also dates from the early weeks of the war; although it cannot be said that the assistance of the French Naval Air Service was really welcomed or appreciated by the critical merchant skippers, or even by some of the patrol boat commanders, until they had proved their efficiency in the summer campaign of 1915. Since then the heavier-than-air seaplanes have been reinforced by a large number of dirigible squadrons and countless observation balloon centers, which maintain a continuous aerial patrol over the entire coastline and assist the surface craft in keeping the German submarines from executing their barbarous attacks with impunity.

"The fundamental conception of this anti-submarine campaign," wrote a French naval officer recently, "and one which failed to foresee the possibilities of submarines with increased cruising radius and more powerful armaments, was apparently based upon the conviction that, if enough patrols, both aerial and surface, could be maintained near the coast, so that no submarine could come to the surface within sight of land without running the risk of being immediately shelled or bombed, the U-boat campaign would be brought to a speedy close. Such an argument would have been admissible if the submarine zone had been limited to restricted areas like the 'Pas de Calais'; but it was not applicable to a campaign conducted in the English Channel and much less to one extended to the North Sea and the Atlantic Ocean. In November, 1917, the American steamer 'Rochester' was torpedoed 340 miles west of the Irish coast, while only recently another steamship was sunk 600 miles from land! Mere defensive tactics and inshore patrols alone could never achieve satisfactory or permanent results."

The first reply to this criticism was the institution of the convoy system, which was first put into effect during the fall of 1917. From that moment, the number of

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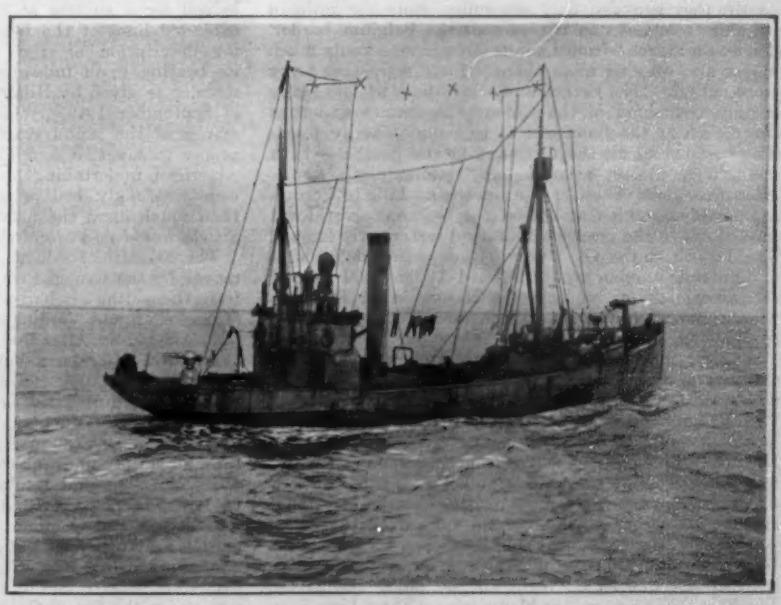
All photographs by courtesy of French Navy

An American-built 110-foot submarine chaser manned by a French crew



French mine-sweeper. These craft saved the day when the U-boats began to be used as mine-layers

Anti-U-Boat operations of the French navy

Strategic Moves of the War, October 16th, 1918

By Our Military Expert

THE events of this great world's war follow one another so closely it is almost impossible to comprehend them or to put them into suitable language for an historical review. Apparently the most momentous occurrences are now taking place and, in a short time, the war aspect may have so cleared that the layman can reasonably grasp the varied happenings and their mutual effects one upon another. Since the last review the Allied armies have continued their advance from the North Sea to Verdun and every move has led to some decided success on the long battle line from Nieuport to Pont-à-Mousson by which the Allies are constantly driving back the Germans and opening their roads to the Rhine and perhaps to Berlin.

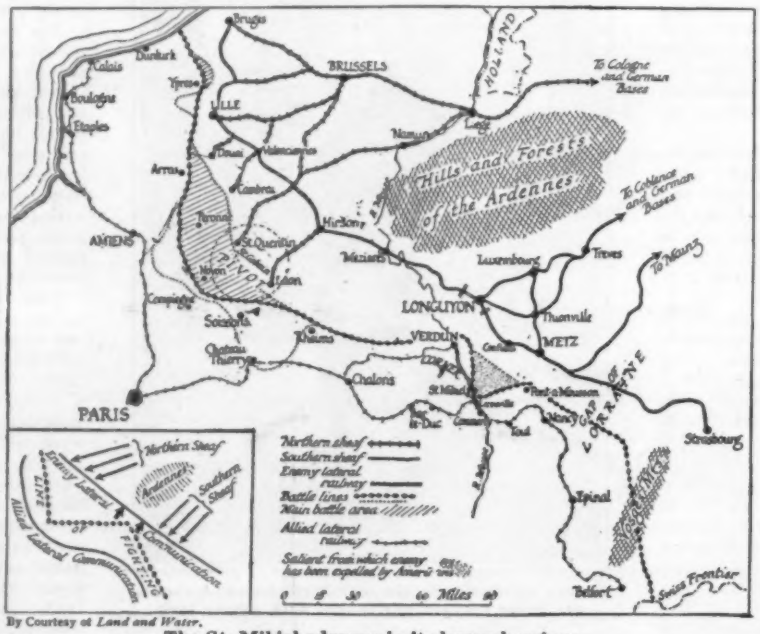
The Belgians and the British Second Army are advancing behind the German lines on the Belgian coast and are pushing a wedge into the German front in Belgium that will cause, probably before these notes are published, the abandonment of Lille on the south and of Ostend, Zeebrugge, and all the north seacoast back as far as Antwerp on the north. This would mean the withdrawal of the Germans behind the Scheldt all the way from Ghent to Valenciennes. Already Roulers, a strong German base of operations, is reported as captured with many prisoners, guns and military stores; and the Allied troops are within a few miles of Courtrai, the chief railway center between Ypres and Ghent. If the advance in this region can be continued the Germans will be forced to evacuate the most important parts of the Belgian coast and the forces in the salient around Lille must retreat or be captured.

In France proper what has happened in Belgium is also occurring, though on a far more gigantic scale. Cambrai and St. Quentin have fallen; Rheims like Ypres and Verdun are far behind the advancing Allied front and little, if anything, is left of the Hindenburg lines that were reputed so formidable and have been found so easy when properly approached in sufficient strength. The Lille and Laon salients are being continuously enveloped, Laon has been captured, and the British and American troops are nearing Valenciennes and the strategic railway at that point.

There seems every indication that the Allies will reach some point on the Belgian frontier near that town before the Germans can get out of the salients at Lille and above Laon to establish a new line of defence near the border. The strategic railway referred to is that running from Lille through Valenciennes to Hirson, Mézières on the Meuse, Sédan, Montmédy and Metz, and has been the main supply line of the German front from Lille to Mézières and Longuyon. The British and Americans are only a few miles from the railway, and, if the latter be cut, the German armies will be broken in two behind Valenciennes and the Scheldt River. Such a success for the Allies would force the evacuation of Lille; in fact, as this is written on October 16th, the occupation of that town, together with Douai, is probably a question of only a few hours.

The loss of Laon is serious. Troops from Lille can get away with possibly no great loss of men and material, since there are railroads running back into Belgium through Tournai and Courtrai; but the troops from Laon and around the St. Gobain massif have no such facilities and are likely to be captured or totally defeated. British, French, and American troops are on their flank along the Oise and are within a few miles of Guise where the Oise bends from a westerly course and runs off to the south; they are also only ten miles from the railroad running from Laon to Hirson near the Belgium border. There is a railroad from Laon to Mézières—a route much longer and offering more chances for a retreating army to be cut off. The French and the Italians are gradually getting possession of the Chemin-des-Dames and thus the mouth of the Laon salient is being steadily closed. The position of all the Germans in the pocket is both dangerous and desperate and may terminate in a wholesale surrender. The German lines from Lille to Verdun are breaking and it may not be long before the world will hear of one of the greatest military disasters ever known. The French in the Champagne have occupied Vouziers and are now moving rapidly toward Attigny and Rethel; the Americans on the east are closing in on Dun-sur-Meuse and pushing on north toward Stenay, en route to Mézières.

A situation has developed through the masterly strategy of the Allied commander that is leading to a widespread German retreat from the North Sea to Verdun and will change the whole front as far as the Vosges mountains. The Germans are a long distance from the Rhine on the western front and must experience heavy losses before they can establish what is left of their armies in defensive positions on the west bank of that river. But it has no doubt been evident to the Allied generals for some time that the Germans would be unable to hold the Belgian coast or even to maintain themselves west of the line from Ghent to and along the Meuse River; for that reason, the blows against them have been continuous at various points. They have probably held on too long at many places and will soon reap the fruits of their errors. But political conditions at home have had an effect on the morale of their troops, which conditions in turn have caused many of their plans to miscarry; this has been especially true of the policy of defensive warfare that has been carried on by them on the western front, apparently with the expectation of gaining compensation for their war losses there by successes in the East. But the latter view has proved a failure, like the efforts for an armistice preliminary to peace; the German army must retire while resisting an enemy of superior strength and equipment; it would therefore seem that a retreat under such conditions is fraught with grave danger of a military disaster. The Allied commanders are pushing the foe and, as a consequence, the German lines are undoubtedly breaking all the way from Lille to La Fère on the Oise and through the Champagne. It is only a question of days when the entire German line will be behind the Scheldt and the Meuse up to Verdun with grave doubt whether even those positions can be held for any length of time. Such a retreat as that behind the Scheldt would free whatever may be left of the great French industrial centers of Lille, Roubaix, Tourcoing, Courtrai and Tournai, as well as Bruges and the Belgian coast. At the present writing the French troops have cut the railroad from Laon to Guise some miles north of Laon. They are advancing rapidly upon Guise and Rethel, which must be soon abandoned by the Germans; the latter in this section and in the Champagne are withdrawing in confusion and are heading rapidly for the Belgian frontier and the line of the Meuse. If the line of the Scheldt can be forced by the Allies or turned, as seems probable, then the next main German defensive, before that of the Rhine, will be the Meuse from the borders of Holland through Liège, Namur, Mézières, Sédan and Stenay.



By Courtesy of *Land and Water*.

The St. Mihiel advance in its larger bearings

A study of the present position of the Allied troops in the Champagne and along the Meuse north of Verdun and the Argonne Forest shows the relation to them of the reduction of the St. Mihiel salient by the American troops in September, and the remarkable strategic foresight that could discern the advantages to be gained by a success at this particular point of the extended lines of the western front. A most interesting description of the capture of the salient and its bearing upon following moves by the Allied commander is given by Hilaire Belloc in *Land and Water* of September 19th. While most inclusive in its summaries of the military situations and moves, it is but proper to say that not all the strategic features of the American undertaking have been, it is thought, sufficiently strongly dealt with by the writer. To do more than touch upon the master points brought out in the article would go beyond the limits of this review.

The St. Mihiel salient had resulted from one of the moves by the Crown Prince, in 1914, to isolate Verdun from the south. It had played a prominent part in the struggles around Verdun up to the time of the German failure in 1916. After that, it had become valueless as an asset to the Germans, but was held more as a part of conquered territory than on account of any military value. But during its occupancy by the Germans, it had answered its purpose.

By a glance at the map it will be noted that the main railroad supply lines for the Allies begin at the Channel ports of Calais and Boulogne, passing through Amiens to Paris, thence via Chateau Thierry, Chalons, Vitry, Bar-le-Duc, and Commercy to Toul and Nancy. They supply practically all the Allied lines and reach Verdun by a branch line from Commercy that was cut by the St. Mihiel salient, and by another line from Chalons that was under the fire of German guns. As a consequence, when Verdun was attacked in 1916, supplies had to be brought up by motor truck from Bar-le-duc. But there was no remedy; so long as the Germans held the St. Miehiel salient, the French armies to the south could not advance into Lorraine with an enemy on the left flank. Similarly no advance could be made on the north toward the iron mines of Briey, without a similar danger to the right flanks.

It is unnecessary to dwell upon the capture of the salient save to say that it was carried out with exceptional skill, as shown by the staff work, and in the incredibly short time of two days. As to the bearing of the fall of the salient upon the present moves, consideration must be given to the German supply lines. On the west the main lines from Germany converge at Liège, whence other lines lead to Lille, Valenciennes, Hirson, Mézières and Sédan. On the north of Verdun the lines come from Coblenz on the Rhine through Luxemburg to the junction at Longuyon whence branch lines go to Mézières, Sédan, Montmédy on the northwest and to Briey and Conflans on the southeast. The Metz and Lorraine fronts are largely supplied from Mainz, on the Rhine through Thionville (Diedenhofen). As already mentioned in this review, there is a long the entire German front and parallel to it, a main railroad line beginning at Lille, and running through Valenciennes, Hirson, Mézières, Sédan, Montmédy and Longuyon, supplying the front by branch lines. The lines of supply from Liège to Mézières are separated from these through Luxemburg and Metz by the Ardennes mountains; these form a rugged and, for military operations an almost impassable obstacle. So long as the German lines were well forward in France, these mountains offered little difficulty to continuous supply to the fronts, but now with American troops almost at Stenay on the Meuse and only a short distance from Montmédy, and French troops at Vouzieres and Rethel and evidently moving on Sédan and Mézières, the Germans are in great danger. Once any of these cities on the main supply line parallel to the front is taken, the Allies will have split the German armies in two; they can then be attacked in succession and driven back to the German borders. The safety with which the Allied troops have been able to move forward to the Argonne and down the Meuse River has been due to the straightening of the St. Mihiel salient, thus getting room for maneuver, avoiding the danger of any flank attack or one from the rear and providing for continuous and uninterrupted supply. It is but another illustration of the remarkable strategic ability and foresight of Marshal Foch.

On October 1st the British forces occupied Damascus, the capital of Syria, taking at the same time several thousand Turks as prisoners. The city was the Turkish base both in Syria and Palestine and its fall means without a doubt an end to all Turkish resistance in the two countries. It is one of the oldest cities in the world and is the junction point of the railroads leading to Aleppo 180 miles northeast, and to the port of Beirut on the Mediterranean Sea. Aleppo is the most important Turkish base in this part of Asia Minor and is the center of the two railroads leading to Palestine and Mesopotamia; it will no doubt be the objective of the British commander's next move. The capture of Damascus itself, shows an advance of 130 miles in the ten days that elapsed after his victorious attacks on the Turks north of Jerusalem; as the case stands, the British have now a clear road from Damascus to Aleppo, especially as a French and British fleet recently captured Beirut and opened the railroad from that town to Damascus. The British troops were last reported about forty miles north of Damascus and are evidently hurrying forward to Aleppo to take advantage of the present demoralized condition of the Turkish armies. This makes the situation of the Turks in Mesopotamia most precarious for it will be necessary for them to withdraw from Mosul and the Tigris to Aleppo before the British reach that city; otherwise their only line of railroad or of good road communications with Anatolia and Constantinople will be cut.

Therefore, in a short time, there will be rapid changes in these theaters of the war; as the hot season is drawing to a close, the British army that took Bagdad will move north and west along both the Tigris and the Euphrates Rivers to a junction with the Palestine army about Aleppo. The Turks will be forced to retire beyond Aleppo and can scarcely offer any serious resistance until they are at or beyond Adana, north of the Gulf of Alexandretta. This will mean the loss to the Turks of Mesopotamia, Palestine, Syria and Arabia and will end their domination in these parts of the eastern world. Even the holy cities of Mecca and Medina are lost as they have passed under the rule of the Arab King of the Hedjaz who has been recognized by the Allied powers. The Armenian problem will also be solved since an army can be sent north from Mosul to Diarbekir and even to Erzerum establishing recognized authority over this much harassed and for many years most unhappy country. So will end Turkish rule in western Asia and the driving back into his native land of Anatolia of the Osmanli, who has made such a failure of government in a

(*Continued on page 344*)

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

The Road Mirage

To the Editor of the SCIENTIFIC AMERICAN:

On July 24th, while traveling in an easterly direction between Canton and Alliance, Ohio, I noticed a car about half a mile ahead apparently perfectly reflected in the roadbed, as if the latter was flooded with water. It was about the hottest hour of the afternoon, the sun was back of us and the road in front was straight almost to the horizon and an exceptionally fine cemented brick surface. When I came up to the "given point" I found the road perfectly dry and the car ahead again showing a reflection in a perfectly mirror-like surface about the level of the bottom of the spare tire. I called the attention of the rest of the party to the reflection, they seeing it very plainly, then and several times later when similar stretches of roadway offered, but each time only above the heated brick surface.

I have traveled the roads in this section since the high wheel days of 1885 but have never been favored with any such phenomena. Can you give me the answer?

New Castle, Pa. C. P. DU SHANE.

The Editor wrote Mr. Du Shane, stating that in his opinion the reflection described was a sort of mirage produced by the heated air in immediate contact with the hot surface of the road. He ventured the surmise that probably the day was dry and quiet, with little or no wind, causing the air to become very hot over the road-bed; and pointed out that under these conditions a total reflection might take place similar to that in the mirage of the desert. This conjecture seems to be well borne out by the following further statement from the correspondent.

To the Editor of the SCIENTIFIC AMERICAN:

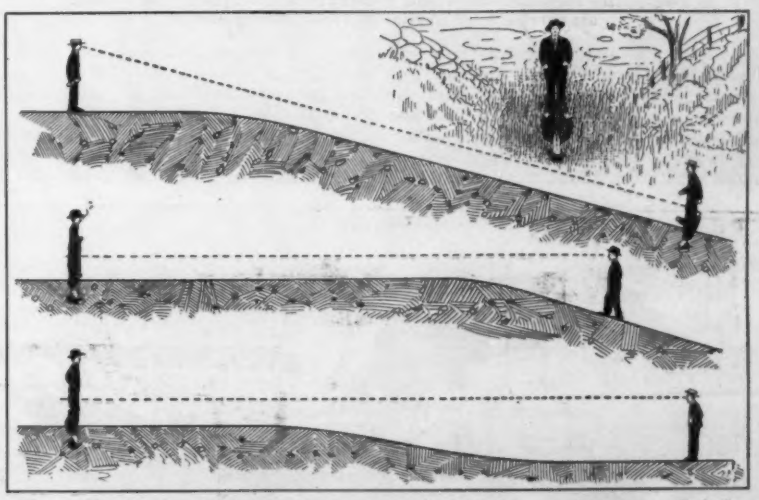
Since receiving your reply to my inquiry, I have been out mirage hunting with some friends and have been successful in bagging some beauties as well as establishing a list of requirements and some conclusions.

The requirements are a very hot, dry, clear day, and a smooth hard road (brick gave the best reflections), leading from the sun. The best time to make the observation is the hottest part of the afternoon. An auto travelling away from you furnishes the best reflection but a person crossing the road stands on his (or her) head very dutifully if you have your line of sight at the proper level.

In Fig. 3 I have shown the best condition for seeing the mirage, the observer riding along a level stretch with his eyes just above the level of the level piece ahead. At the distance of a mile you will see almost the entire car reflected in a mirror-like surface about the bottom of the spare tire. Your first impression is that the machine is in water up to that point, but when you come to the given point you find the water has evaporated. The best point of observation I have found is the stretch between Canton and Alliance, but any similar road should give equally clear reflections. The shortest distance at which a reflection was seen was about two squares at the west end of the viaduct at Ellwood City, Pa. At this point the mirage was perfectly distinct, but on account of the shortness of the "mirror" not more than a foot of the height of the reflected object showed.

In Figs. 1 and 2 I have tried to show you why this phenomenon has not been noticed. The only times at which your line of sight is level with the road ahead is when you are passing through that level—extended—at some speed. Unless we have the set-up of Fig. 3, with precisely the right difference in height between the two requirements of the road, the point of observation is less than an inch in diameter, so that the time for observation is probably one hundredth of a second. Of course, the present condition of the atmosphere may be abnormal, but I feel sure that any one who has the patience to find the first mirage will follow up the matter as we have done.

New Castle, Pa. C. P. DU SHANE.



The road mirage, and the circumstances under which it may be seen. Only in the third case is it visible for more than an instant, since the eye passes quickly through the correct level

Alien Property

To the Editor of the SCIENTIFIC AMERICAN:

I will greatly appreciate it if you will call the attention of the readers of your publication to the provision of the "Trading with the Enemy Act" which provides that all money or other property held by, for, or for the account of, or the benefit of, an enemy or ally of enemy, should be immediately reported to this office. This includes patents, trade-marks, copyrights, prints, labels, and designs.

In connection with the last named, the following persons are required to make report to this office:

All persons who are in any manner interested in the use or operation of any enemy owned patent, trade-mark, copyright, print, label, or design, including joint inventors, where one of the inventors is an enemy within the provisions of the "Trading with the Enemy Act." Assignees of an undivided part or share of an invention, or right to carry on a process or operate under a trade-mark, copyright, print, label, or design within and throughout a specified portion of the United States, when such patent or process is enemy owned. Mortgagees and licensees of enemy owned patents, trade-marks, copyrights, prints, labels, or licenses. The above includes guardians, executors, and administrators.

It is to be emphasized that enemy status is largely a matter of residence. Even American citizens living in enemy territory come under the provisions of the Act, as do American wives of enemies. In addition, neutrals doing business with the enemy or engaged in enemy propaganda are subject to property seizure.

Any information regarding the enemy interests in any patents, trade-marks, copyrights, prints, labels, or designs, should be forwarded immediately to Francis P. Garvan, Director of the Bureau of Investigation, Alien Property Custodian's Office, Washington, D. C., even if the information is only gossip or rumor. Oftentimes a clue to important enemy interests is obtained in this way. I feel sure that I can count upon your coöperation in the work of uncovering money and property of enemy character. The money thus obtained is invested in Liberty Bonds, and is made to fight for our country, instead of against it.

A. MITCHELL PALMER,
Alien Property Custodian.

Washington, D. C.

Volcanoes and Glaciers

To the Editor of the SCIENTIFIC AMERICAN:

Some time ago, I think in 1882 or 1883, the volcano of Krakatoa in Oceanica erupted. The whole top of the mountain was blown off. This eruption was followed by abnormally cool seasons and the sunsets took on a peculiar magenta tint, due, it was claimed, to the amount of volcanic material thrown into the atmosphere. These conditions were not local but world-wide.

A few years ago the volcano of Katmai in Alaska erupted most violently and large quantities of dust were projected into the atmosphere; the dust from this eruption was recognized as far away as the coast of Northern Africa. This was also followed by cool seasons. After reading in the *Geographic Magazine* the account of the Katmai eruption and the resulting cold season the idea came to me that conditions similar to the above may have caused the so-called "ice ages."

Suppose a large number of volcanoes in the northern hemisphere had been in continuous eruption for a long time, and had filled the atmosphere with great quantities of volcanic matter thus obscuring the sun and preventing the heat rays from reaching the earth, may not this have caused a lowering of temperature sufficient to cause non-melting of the snows and consequent formation of glacial conditions? JAMES H. BEEBE.

Rochester, N. Y.

Tool Men to Make Guns

To the Editor of the SCIENTIFIC AMERICAN:

The Naval Gun Factory is in need of competent tool, jig and gage designers. Men who are graduates in mechanical engineering from a technical school or college of recognized standing and have had some drafting experience, or men who are competent designers of jigs, tools and gages and have had a number of years' experience in the designing of shop tools are eligible for these positions.

The pay ranges from $4 to $6.88 per diem, depending upon the qualifications of the draftsman.

Additional information may be had upon inquiry.

COMMANDANT AND SUPERINTENDENT.

Naval Gun Factory, Navy Yard, Washington, D. C.

The Kerosene Lamp

To the Editor of the SCIENTIFIC AMERICAN:

While the use of the mantle increases the efficiency of the kerosene lamp as described in the last issue of the SCIENTIFIC AMERICAN, it does not reduce the labor of caring for it. Keeping the chimney clean is the great objection to the use of the kerosene lamp in any form.

Usually the flame is extinguished with a puff of the breath, and the oily smoke rises through the chimney, soiling and discoloring it. If, however, instead of a short breath or puff, a long one is used the smoke is all forced out at the chimney base, a matter of at most but a second or two. And, this means a saving of time in cleaning and of fragile chimneys as well.

G. S. PAINE.

Winslow, Me.

A Fifteenth Clause

To the Editor of the SCIENTIFIC AMERICAN:

Why would it not be wise for the President to add a 15th clause to his peace ideas, viz.; that all obligations incurred by the central powers since July, 1914, should be repudiated? Then when it came to indemnities for France, Belgium, Serbia, etc., the credit would be good so a bond of the central powers would be worth something. It might not help their "Slavery Loans" when they launch them, but it might hasten the end of the war and be only just.

Such repudiation might pinch some of our pro-Hun American citizens, but the nation could stand it.

Why does not that suggestion square with the "justice" that we talk so much? Every one who has ever bought a bond of the central powers knew he was helping injustice.

E. F. JOHNSON.

Portland, Ore.

Why Foreign Trade?

To the Editor of the SCIENTIFIC AMERICAN:

I have read with much interest the foreign trade page which you have inaugurated, and would like to comment upon American trade, and foreign trade in general.

About nine years ago, while residing in South Africa, I bought some American implements; but after using them, I concluded that it would be better policy to pay more for more reliable goods from England or Germany. Spare parts for the American machines were a particular nuisance, costing too much and leading to great delay and loss of working time while waiting for them. As an admiring outsider, I think your manufacturers excel in packing and containers generally—although I know that they have been criticised on this very point. I am quite clear that the spare parts situation constitutes a great weakness in your foreign trade program, and one of the rocks on which it will split, if split it does. Exporters should remember that distant buyers will want spare parts quite as badly and quite as quickly as the man around the corner, and should provide means whereby foreign purchasers can obtain replacements reasonably and quickly.

It seems to me, however, that foreign trade is not one of the chief aims of existence; and I hope that America will be spared experiencing consequences similar to those which the English had to suffer as a result of the "Manchester School's" policy of exploiting their less wealthy countrymen and foreign markets. It seems to me that, if a country has every natural essential to prosperity and progress, all or most of its foreign trade is really a national loss. The labor spent to benefit foreigners might better be diverted to serve those within the national boundary; while in time of war the dependence upon others, in some line at least, which foreign trade necessitates, is a source of weakness.

For example, Australia has gone to extremes on the foreign trade idea. She exports products of the soil, and gets back manufactured articles; yet compared to your country, she lacks the enlightenment and progress and strength, though she has natural resources in quantity almost sufficient to support hundreds of millions of people. Surely the dyestuff industry is adequate proof of the weakness of the foreign trade policy? You cannot sell without affording the purchaser facilities for paying; in foreign trade, you cannot supply one commodity without a corresponding dependence for something else in return.

Perhaps my reasoning is faulty—I suppose it is, since it is not that which is generally accepted. But I am unable to bring my mind to any other conclusion.

E. A. PARSONS.

East Malvern, Australia.

Germany After the War

To the Editor of the SCIENTIFIC AMERICAN:

We note an article in THE SCIENTIFIC AMERICAN regarding treatment of Germany regarding coal.

By all means every basic supply of raw material should be taken from Germany allowing them to purchase same on the open market the same as many other nations are obliged to do; they can get along this way and the world will be safer with control of raw materials in the hands of nations that have a little sentiment.

We note in addition that there is considerable talk about Germany's spending large amounts in attempts to build up foreign trade, still as we have never seen any reproduction of any of their advertising campaigns, we feel that copies of their campaign should be sent around to show just what is doing.

L. J. MONAHAN.

Oshkosh, Wis.

Training Our Aerial Bombers

How We Are Putting into Practice the Experience of Our Allies and of the Enemy

Illustrated with Photographs of Some Recent Allied Bombing Planes

DURING the first year of war there were no aerial bombing organizations in the Allied flying corps. Practically all the work in the air was in the nature of observation. No pilots could be spared for anything else, whereas today probably 25 per cent of the aerial arms are bombing squadrons of 12 machines per squadron.

The first bombing was done by volunteer pilots who flew over the German lines and dropped three or four bombs made from artillery shell on concentration camps and cantonments. Showers of small steel arrows were sometimes spilled upon convoys, troop trains, and bodies of massed troops. The Germans, however, began regular day bombing of cities in 1915, and the Allies bombarded Karlsruhe in reprisal in October of the same year. From that date on the evolution in organized bombing developed rapidly. Some time later the French began night bombing, but this was not undertaken by the Germans until August, 1916.

Today large groups, including several squadrons of bombing machines, go over the lines from time to time and completely destroy their objective, be it a city or a camp, a column of troops, or a trench system. Unfortunately the Allies' air forces have to travel for many miles over hostile territory defended by anti-aircraft guns to attack German cities, while the enemy can attack French cities by flying only a short distance beyond our lines. But as time goes on the machines become larger and more powerful; in fact, today the difference in distance traveled by the German and the Allied bombers counts for little as compared with two or three years ago.

The Allies are developing large bombing planes with marked success. These machines carry sufficient fuel for long excursions into hostile skies and are provided with armament to protect them when they are attacked by airplanes. Bombing squadrons are usually escorted over the lines by fast fighting squadrons of 18 planes per squadron, and then left to their own devices, for the fighters seldom carry sufficient fuel to permit accompanying the bombers on the round trip.

After an excursion of this sort, the returning bombers receive a warm reception from the anti-aircraft guns when they again pass over the enemy lines en route to their airdromes. Like fighting squadrons, the bombing planes fly in a formation so designed as to permit the planes to protect their mates from aerial attack. The usual formation is the "V," with the leading plane lowest and the following planes arranged in pairs, one on each side of the "V," and each pair a certain number of feet higher in the air. This formation is something like a pointed flight of steps, thus permitting the higher planes to pounce upon enemy planes which essay an attack on any of their fellows below.

The training of bombing crews, which comprise a pilot and a bomber, is as important and exacting as is the teaching of any of our other highly specialized branches of the air service. It may sound easy to the layman to fly over a certain spot and drop a concentrated form of high explosive upon it. But the most comprehensive training is necessary in flying, aiming, firing, navigating and fighting.

The dropping of the bomb itself is similar to shooting a rifle. First, you set your sights and wind gage, then you hold the rifle properly, and finally you pull the trigger at the proper moment. Then, if your ammunition is standard, you hit the target. It is the same with bombing. If you set your sights correctly, fly your plane correctly over the objective, and drop the bomb at the proper time, you will hit the target. Then, if the ammunition makers gave you good bombs, the objective will be destroyed.

Two-seater reconnaissance and fighting A-R machine of the French air service used to convoy day-bombing planes

The elemental training is given the bomber and the bombing pilot alike at the preliminary or ground school. It includes theory and practice in everything except work in the air. This instruction is intended to make the future officers intelligent and efficient in military duties and flying practice. It consists of a hard grind for about three months, but the men learn discipline and drill, and become familiar with the customs of the service by the time they graduate. Their special technical training includes the theory of flight, aeronautical engines and instruments and airplanes. Some of them could build workable machines by the time they are through.

It is after this preliminary work that the men are selected for the special branches of the air service. A certain number who stand well in their class are permitted to volunteer as bombers.

The bombers first receive a week of concentrated theory on bomb explosives, exploding and sighting devices, and all the theory pertaining to "laying an egg on the Hun," as this new form of fighting is termed. It is at this stage of the game that the bombers and bombing pilots meet, but it is an earlier class of pilots with whom the bombers are paired. The pilots are reserve military aviators and can do all the "stunts," fly cross country or by compass and maps. They are also trained in formation or squadron flying.

In this period, known as the preparatory bombing stage, the bombing crews learn to fly a proper course over camera obscuras and Batchelor mirrors. These instruments, located in houses on the ground, are open to the sky so that the course of the planes flying over them can be traced on charts. The charts show up even the smallest errors in the movements of the crew.

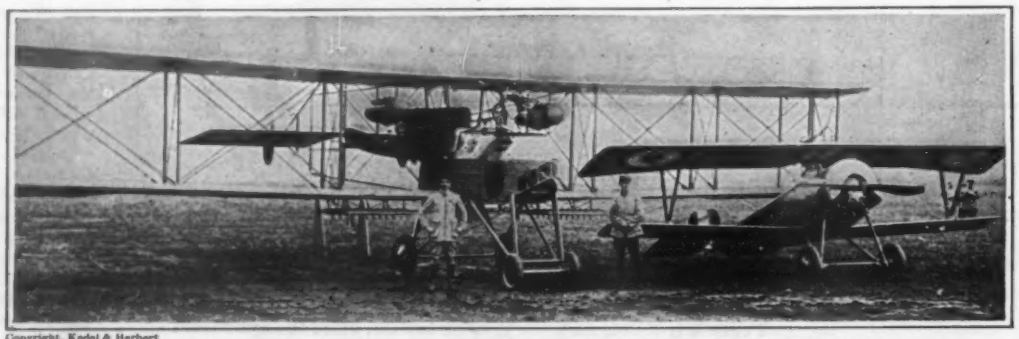
When the embryo bombers come down expert instructors collect their errors, showing them how to improve their work. When all their faults have been corrected and the crews have been shifted around until the most efficient combinations have been secured, the men pass on to the bomb-dropping stage. They are started flying at low altitudes, with conditions made as easy as possible, then they are sent up to between 3,000 and 4,000 feet, where they continue to practice until they can hit the target. The target is a circle 25 feet in radius, painted on the ground and would not be very hard to hit with a rifle from that distance, provided a steady platform were available. But these men, nearly a mile in the air, are under way all the time and the plane is far from steady. They pass over their target at a speed of more than a mile a minute while they aim and "shoot."

Foreigners claim that Americans are prone to exaggerate, but in this case the proof is available at the fields. Nine out of ten bombing crews can score seven hits out of ten shots at this stage.

The next period of training takes the men higher in the air. They ascend to between 6,000 and 12,000 feet. Here, while in training, they do not have to worry at all. They worry but little more in action; for in the higher levels of these ranges, say 10,000 to 12,000 feet, the Boche doesn't average better than one hit to every 50,000 anti-aircraft shots. So our bombers will be comparatively safe enough at these heights.

At the 10,000-foot level the same sized target is used—differing from small-arms practice. It looks like a diminutive flyspeck on the ground, nearly two miles below. The pilot is navigating the ship on an even keel at a certain speed, in order that it will pass directly over the target.

The bomber, having taken into account the speed of the



Copyright, Kadel & Herbert

Typical long-distance night bomber and a Nieuport scout, showing the difference in size between planes for bombing and for fighting

Copyright, Kadel & Herbert

Twin-engined Morane-Saulnier night bomber employed by the French air service for long-distance night raids

Twin-engined three-seater bombing and reconnaissance plane of the Letort type, especially suited to long-distance photographic work

ship, the elevation and the wind, has set his sights and looked to his releases and bombs. Now he peers intently through the sight, his finger on the release trigger. As the target below passes the cross wires in the sight, he pulls the trigger. The bomb is released; and for 25 seconds the bomber watches the bomb travel on its course until the white ball of smoke shows where it has landed in relation to the target. These are plaster of paris bombs, balanced and weighted the same as real bombs, but not "loaded."

Our bombing crews have to be able to hit moving targets as well as still ones, even moving trains and surprise targets. Incidentally, they must hit the dummy train and not the neighboring fields. Practice is also given them in diving upon a moving target.

Having passed these stages, the fine points of bombing are now given to the crews. They are taught how to get pictorial information of enemy country. In this and subsequent stages perfectly peaceful and innocent towns adjacent to the bombing fields are sometimes subjected to bombardments.

Finally the most advanced work is taken up, namely, night bombing and raiding.

Besides their training in bombing, these aviators and observers have a thorough training in aerial gunnery with fixed and flexible machine guns, which shoot accurately at 100 yards and at the rate of 500 shots per minute.

French Official

A Voisin bombing plane for night raids. This type has been employed since the opening of the war

Where Armies Sail to Battle

THE rivers and canals and other waterways of France have served to good stead in Allied hands, especially of late when the entire front has been ablaze with many battles which are to determine the future of the world. Indeed, these waterways, which might at first be considered military obstacles, are proving invaluable in the transportation of men, food, material, horses, guns and so on to the fighting line.

Like their other Allies, the French and Belgians, the British have made full use of the waterways in their sectors. Thousands of troops are moved up to the battlefront in huge canal boats drawn by special motor boats. In the same manner the horses and guns and huge stocks of supplies are constantly transported on boats where waterways are available, thus relieving the already heavily-taxed railways. Better than words the accompanying illustrations speak for themselves of the activities of the British army along the canals and rivers of France.

All photos British Official

Tens of thousands of Britain's armed legions have been transported to battle on such canal boats as this one, towed by motor boat

The Virgin Islands Census

THE Federal Government has just published an octavo volume of 174 pages which sets forth in detail just what we got when we bought the former Danish West Indies. The census, which was specially undertaken at the request of the Navy Department, shows that as a result of this purchase we have increased our area by 132 square miles. This is practically the combined area of St. Croix, St. John and St. Thomas; of the 50 smaller isles and islets, none is of greater extent than one square mile, while many have a surface better expressable in acres than in the larger unit.

The population as of November 1st, 1917, is 26,051; there has been a steady decrease since 1835, when the islands contained 43,178 persons. Of the present population, 75 per cent is black, 7 per cent white, and 18 per cent mixed; the excess of females amounts to 8 per cent of the entire population, which is unusually large. Some 25 per cent of the population is illiterate. In spite of Danish control lasting for 245 years without a break, the prevailing language is English. The largest city is Charlotte Amalie, on St. Thomas, with 7,747 inhabitants. The only other considerable towns are Christiansted and Frederiksted, both on St. Croix.

It goes without saying that agriculture and animal husbandry are the leading occupations. In fact, over 80 per cent of the total area is included in the farms and estates. The value of all crops for the year was $522,606, of which sugar cane constituted $442,120. Of what little manufacturing there is, sugar refining takes up 62 per cent of the wage earners, 76 per cent of the invested capital, and returns 80 per cent of the total manufactured value.

A few empty oil drums and a few sticks form the raft of this sport-seeking Tommy

A New Fertilizer from Italy

IN view of the attention being given everywhere to increased production, and the growing realization of the relation that fertilizers bear to successful agriculture, it is of interest to chronicle a new fertilizer now being employed in Italy under the designation "tetraphosphate."

The process of manufacture is very simple. In a specially constructed furnace the natural phosphate-rock powder is roasted for several hours at a temperature varying from 600° to 800° C., together with six per cent of a powder composed of equal parts of the carbonates of calcium, sodium and magnesium, plus a small proportion of sodium sulfate. This powder furnishes the reactive agent for this stage of the process. After leaving the furnace, the product is hydrated by cold phosphoric acid, and for practical use is mixed with sand or dry earth until the necessary strength is obtained.

A special commission appointed by the Italian Minister of Agriculture has experimented with this fertilizer in connection with wheat, rice, potatoes, oats, beans and clover. In addition to the verdict that it is the equal if not the superior of superphosphate, the following specific advantages are credited to it.

It is free from causticity, acidity and deterioration. The manufacture is simpler and less costly; in particular, installation costs for a typical plant are but 150,000 francs with lead at its present price, as against a million francs for a superphosphate plant of equal capacity. Finally, it is possible to manufacture it from natural phosphate of much lower percentage than in the case of the familiar product.

Agricultural Research in the Virgin Islands

AGRICULTURAL research in the Virgin Islands is provided for in the appropriations for the U. S. Department of Agriculture, for the current fiscal year. The Danish authorities established an agricultural experiment station near Christiansted, St. Croix, in 1910, which ultimately included a tract of 225 acres. This station is to be taken over by the States Relations Service of the Department of Agriculture and the staff will be increased. Besides continuing experiments on sugar cane, cotton, vegetables, etc., the department is likely to investigate the live stock possibilities of the islands. Dairying is now almost unknown there. The leading crops are sugar cane and Sea Island cotton. An agricultural survey of the islands has been made by D. W. May, agronomist in charge of the Porto Rico experimental station.

Engineers lifting a temporary bridge for a motor tug to get through on its way to the battlefront

Wounded horses being taken aboard a hospital barge for transport to veterinary hospital

The Heavens in November, 1918

Large Returns From the Study of Variable Stars

By Prof. Henry Norris Russell, Ph.D.

WE have had occasion more than once in these columns to describe the remarkable work of Dr. Shapley, of the Mt. Wilson Observatory. Another installment of his studies based on the brightness and the colors of the stars has just appeared in detail, and again contains results deserving mention here.

This portion of the discussion relates to that very interesting class of variable stars of short period known as the Cepheid variables, from the star Delta Cephei, one of the most conspicuous members of the class. Reference to these stars has been made on various occasions in these columns. They are characterized by a very regular variation, with periods varying from star to star, and ranging in all from more than a hundred days to less than four hours; but they fall into two well marked groups—one with periods of from four to twenty days, the other with periods of from eight to fifteen hours—which includes the great majority of the members of the entire class. The variation in brightness is continuous, and the rise to maximum is almost always more rapid than the subsequent fall to minimum. The range of variation is usually less than one magnitude; that is, the star is twice as bright, or in rare cases three times as bright, at its best as at its faintest.

Along with the variations in brightness go concomitant changes in color and in the spectrum—the star being redder when faint, whiter when bright, and the spectrum varying in corresponding fashion. This behavior indicates strongly that these stars are subject to actual changes of temperature, growing alternately hotter, and hence brighter and whiter, and colder, when they become fainter and redder; but little is yet known of the physical cause of these changes.

For the present purpose, however, it suffices to note that the variation of these stars is of a very distinctive type, so that, once the light-curve of a variable star has been determined, it is possible to say with certainty whether it belongs to this class or not. Another very curious characteristic of these stars is that their brightness depends upon the period of variation. This was first discovered by Miss Leavitt at Harvard. Studying the variable stars in the Small Magellanic Cloud—one of the two remarkable outlying patches, similar to the Milky Way but remote from it, in the southern hemisphere—she found that all the stars of the same period were of about the same apparent brightness, while those of longer period were brighter, and those of shorter period fainter.

Now there is little doubt that almost all of the fainter stars which we see in these clouds are really members of the great swarm, and hence are all at about the same distance from us. So those which look the brightest to us are really the brightest—which is far from being the case among the scattered stars in the sky at large, with enormous differences in distance.

Brightness vs. Distance

To find out how bright these variables are, in comparison with the Sun, we would need to know the distance of the Magellanic Cloud, which is far beyond our present means of direct measurement. Fortunately we have other means of attacking the problem. There are about a dozen variable stars of the Cepheid type that are bright enough to be visible to the naked eye, and so are presumably far nearer to us than those in the star-clouds. Even so, their very small proper motions indicate that they are not attractive objects for the direct measurement of parallax and thence of distance. But the proper motions themselves give us the necessary clue. Small as they are, they have been very precisely determined by a century of observation, and, when plotted on a globe, they show definitely the streaming effect which arises from the motion of our own system through space.

The available objects are so few that, if they were themselves moving rapidly in space, their motions would confuse the effect of the solar motion; but spectroscopic observation of the motion in the line of sight shows that the "peculiar" motions of these stars are unusually small, averaging about eight kilometers per second. This fortunate circumstance makes it possible to derive trustworthy values for the average distance of these stars by considering their "parallactic drift" due to our motion in space past them. This calculation was first made by Hertzsprung of Potsdam, later by the present writer, and has now been revised by Dr. Shapley. All investigators concur in finding that these stars are exceptionally luminous—Shapley's conclusion being that the average brightness of such a star, of period about six days, is 750 times that of the Sun. What is more, it is evident, even among this small number of stars, that the stars of longest period are the brightest—thus confirming Miss Leavitt's discovery, from quite independent sources.

If now we are willing to assume that a variable star of this type, over a period of (say) six days, in the Magellanic Cloud, is of the same real brightness as a star, varying in just the same way, and with the same period, which lies near enough to us in space to be investigated, we are in a position to estimate the distance of the Magellanic Cloud, and the brightness of all the stars in it.

Amazing Distances and Sizes

This assumption, though not rigorously proven, seems a safe one to make. Applying it to Miss Leavitt's list of stars, Shapley finds that those with the longest periods, about 100 days, have the enormous brightness of 23,000 times that of the Sun. This is the average of the maximum and minimum brightness, so that at maximum these stars average more than 30,000 times as bright as the Sun. A Cepheid of period 30 days is, on the average, about 7,000 times the Sun's brightness; one of ten days period, about 1,600 times as bright as the Sun; one of three days period, about 300 times as bright as the Sun; while the variables of short periods, less than a day, appear to be all of about the same brightness, giving out in the neighborhood of 120 times as much light as the Sun. This last conclusion is derived mainly from a study of the numerous variables of this type appearing in the globular star-clusters. These can be connected with the general scheme because, luckily, a few brighter variables, of longer period, are also found in the clusters, which appear to be comparable with those previously investigated.

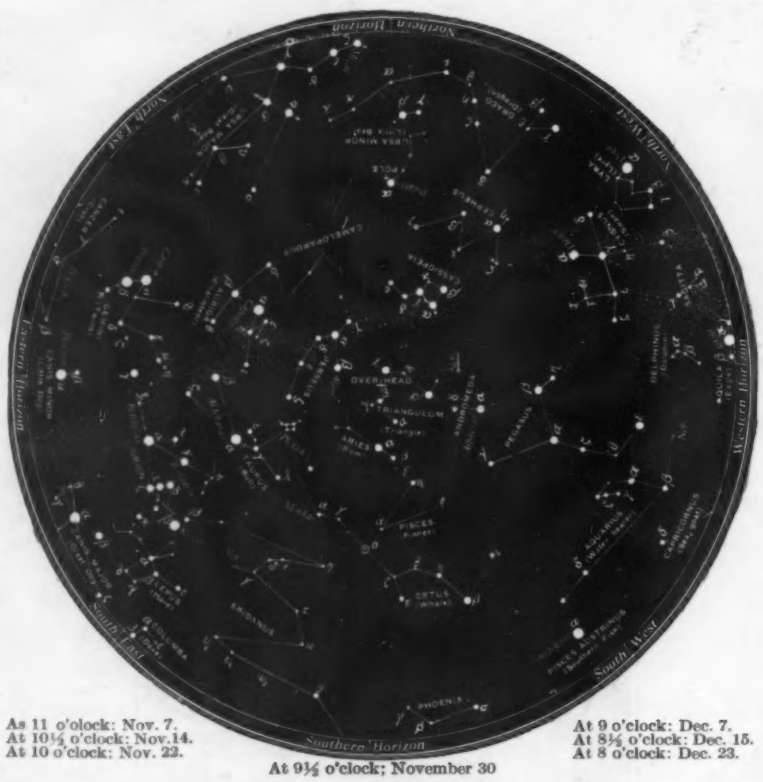
This remarkable series of facts is at the same time of great interest in itself, and of great importance in the study of the more distant parts of the sidereal universe. If we can tell the real brightness of a variable star of this sort simply by determining its period, we can combine this knowledge with our observations of its apparent brightness, and find the distance of the star—and, if it happenes to be a member of a star cluster, the distance of the cluster as well.

In this way Shapley (following a similar calculation by Hertzsprung) computes that the Small Magellanic Cloud is at a distance of 62,000 light years, and also derives the remarkable information concerning the distances of the globular star-clusters of which we spoke several months ago. There is good reason to believe that, within a few years, this powerful method will lead to the measurement of the distance of the remotest parts of the Milky Way, and enable us to get at least a trustworthy idea of the size of the visible universe. It has already shown that the latter is enormously larger than anyone had previously supposed.

Of no less interest will be the study of these extraordinary stars themselves. The typical Cepheids, of period six or eight days, are very similar to the Sun in color and spectrum, and are probably of roughly the same surface brightness. This would indicate that their diameters are from twenty to thirty times that of the Sun, which, in view of what we know of certain other stars, is by no means an unreasonable conclusion. The short-period Cepheids are white stars, with spectra like Sirius, and are probably much hotter than the Sun, so that it is likely that, on the average, their diameters are three or four times the Sun's. But the Cepheids of longest period are conspicuously red, and probably give out much less light per square unit of surface than the Sun. From Shapley's data, which at present are provisional in the case of these long-period stars, it may be roughly estimated that a Cepheid of 100 days period would be of about one-twentieth of the Sun's surface brightness. This would lead to the amazing conclusion that such a star is about 800 times the Sun's diameter—or seven hundred millions of miles—big enough to include all the inner planets of the Solar System within its bulk, and almost as large as the orbit of Jupiter.

Such a conclusion is truly remarkable; but there is nothing absurd about it, or even improbable; for the idea that the stars may have originated through the condensation of huge masses of diffuse matter is as old as Laplace, and proably older.

The investigation of the physical condition of such bodies promises to be of fascinating interest. Dr. Shapley has announced his intention to discuss the existing evidence in a forthcoming paper. Until then, we may well be content with the marvels that have been unveiled.



As 11 o'clock: Nov. 7.
At 10½ o'clock: Nov.14.
At 10 o'clock: Nov. 22.

At 9 o'clock: Dec. 7.
At 8½ o'clock: Dec. 15.
At 8 o'clock: Dec. 23.

At 9½ o'clock; November 30

NIGHT SKY: NOVEMBER AND DECEMBER

The Heavens

The winter constellations are returning once more to view. At the hours stated below the map Orion is well up in the southeast, the line of his belt pointing toward Sirius, and upward toward Aldebaran. Procyon is low in the east, Castor and Pollux are above and to the left, and Capella still higher. The Great Dipper is low on the northern horizon. The dragon and the little bear are below the Pole, while Cepheus and Cassiopeia are higher up, with Perseus directly overhead. Cygnus and Lyra are low in the northwest, Pegasus high in the west, and Andromeda still above him. Aquarius, Eridanus and Cetus occupy the huge dull area in the southern sky.

The Planets

Mercury is an evening star all through November, and is best seen at the end of the month, being at elongation on the 30th. As he is very far south, in Scorpio, he will be hard to see, setting about 5.35 P. M. Venus is a morning star until the 23d, when she passes behind the Sun, escaping by only a few minutes of arc being actually hidden behind his disk. She is practically invisible during the month.

Mars is an evening star in Sagittarius, setting at about 7 P. M. in the middle of the month. Jupiter is in Gemini, and is fast becoming conspuicous in the evening sky. By the end of the month he rises at 7 P. M. and is well up in the later evening.

Saturn is in Leo, and is in quadrature with the Sun on the 20th. On this date he rises at 11.20 P. M. and crosses the meridian at 6 A. M. Uranus is in Capricornus, and is in quadrature west of the Sun on the 16th. He is observable in the early evening. Neptune is in Cancer, and is in quadrature east of the Sun on the 2d, so that he can be seen in the morning hours.

The Moon is new at 4 P. M. on the 3d, in her first quarter at noon on the 11th, full at 3 A. M. on the 18th, and in the last quarter at 5 A. M. on the 25th. She is nearest the Earth on the 16th, and farthest away on the 1st and again on the 29th. While making the circuit of the sky, she passes near Venus on the 3d, Mercury on the 4th, Mars on the 7th, Uranus on the 12th, Jupiter on the 21st, Neptune on the 23d and Saturn on the 25th. None of the observable conjunctions is close.

In spite of the fact that continuance of the summer time for an indefinite period beyond its legislated termination on October 27th, is being urged, we have used standard winter time throughout the text and in the captions for the map. If the clocks are not returned to normal, the hours mentioned must in every case be advanced by one.

Mexican Seismology

AN elaborate account of seismological observations and studies in Mexico from the earliest times down to the year 1917, written by M. Munoz Lumbier, has been published as Bulletin 36 of the Institute Geologico de Mexico, the institution which had charge of the seismological work of the country until recently, when these activities were transferred by the government to the meteorological service. The author of the bulletin pleads for the return of the work to the Geological Institute. Among the interesting charts in this volume is one showing the degree of seismicity of various parts of Mexico and another showing the distribution of known earthquake foci. The seismological stations of Mexico suffered severely in the recent revolutions, and of the six important ones that were in operation before 1914 only two, at Oaxaca and Mazatlan, are now active.

World Markets for American Manufactures

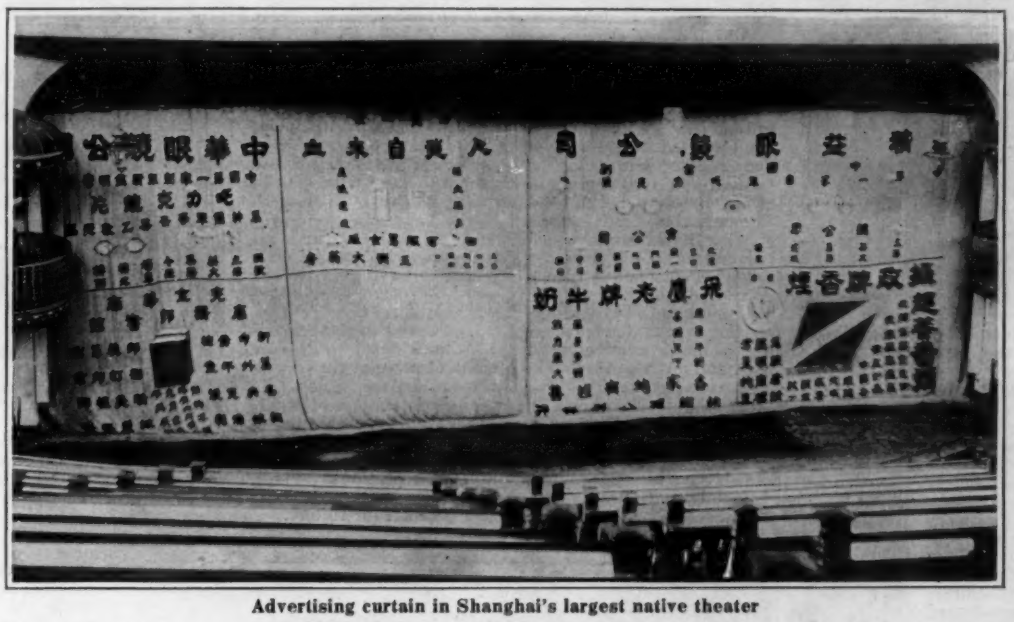
Edited by LYNN W. MEEKINS

A department devoted to the extension of American trade in foreign lands

China's Second Childhood

THE Rip van Winkle of nations, China, is stretching itself after a nap of many centuries, shaving its beard, polishing its spectacles and examining the styles in wrist watches. In its youth China was progressive and had an inventive turn of mind. It started a great many things and then let well enough alone. For more than 4,500 years China's millions lived on rice and wheat prepared from the grains by hand and were clothed with hand-woven material made from hand-spun yarn. When the industrial alarm-clock went off fifty years ago, machinery began to be introduced, and now high-speed rotary rice hullers and modern flour-milling machinery are at work in many parts of the country. In its textile mills China now has nearly 1,500,000 spindles. In addition to food and clothing thousands of other things are being made by improved methods.

A notable effect of the war in China has been to increase wages, resulting in a rising standard of living and a greater demand for comforts. A great many American manufacturers have passed up China because of its very low purchasing power. The majority of the people formerly bought only the cheapest goods. Now, however, the world is short of raw materials, certain Chinese products are in great demand and the country is prospering. But for the civil war—which the newly elected president seems to have a fair chance of stopping — China's foreign trade record last year would have been much better. Even with this handicap it showed an advance over 1916, and promises well for the future.



Advertising curtain in Shanghai's largest native theater

Factors Favoring American Trade

Thanks to the foresight which prompted the return of the indemnity following the Boxer Rebellion in 1900, to the generous treatment of Chinese students in this country, and to the effective educational work carried on by Americans in China, we are the most favored nation in Chinese trade, and we have an excellent chance to get more of it. Seven years ago a young man came from Shanghai to a technical school in New England, from which he graduated with honors and obtained employment with a large American corporation. When he returns, not only will he be very valuable to this country, but he will carry with him a liking for many American products that his friends will be interested to know about. During his stay in the United States he acquired a taste for Western cooking, preferring American dishes to many of the Chinese foods. He will be able to buy numerous American canned goods in China, where they have been vigorously pushed by our salesmen. Imported biscuits and candies are in great demand. Canned fruits are coming into favor and asparagus is now served in the large Chinese restaurants in the treaty ports.

When this young man returns to Shanghai he will be surprised to find more than a thousand automobiles, mostly of American make. On account of its river system, which has provided easy inland transportation, China has paid little attention to building good roads, but sales of American motor cars have been advancing in the principal cities. He will not find it so difficult to buy imported clothing, more than $1,500,000 worth of woolen coatings and suitings have been purchased from abroad in 1917, and almost as large a quantity of woolen and cotton goods.

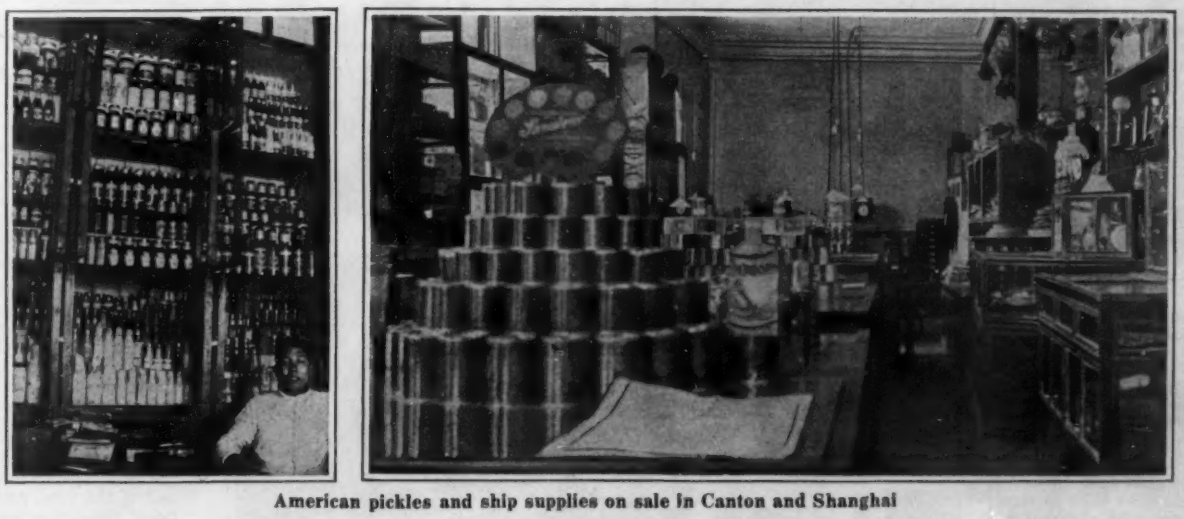
Features of the Chinese Market

"The most important factor affecting the sales of foreign goods in China is price," said the representative of an American firm. "The Chinese buyer will spend an hour bargaining in the hope of reducing the price of an article only one cent. Nor is the time wasted, for in many cases that one cent is more than his earnings for the hour. How little he can pay and get an article that will answer his immediate needs is foremost in the mind of the Chinese purchaser of American hardware. The Chinese are accustomed to buy certain lines as a matter of habit, and if they are used to seeing an article painted green they will refuse a better article at the same price if it is colored red. Bright finish is essential, as the Chinese associate brightness with newness and often decline to buy a dull-looking article, even though it may be superior.

"It is impossible to do direct business with the Chinese through correspondence, except with those who have been educated abroad, most of whom enter official instead of business life. Granting agencies solely through correspondence is to be avoided. In the judgment of an American who has lived in China for many years, American manufacturers will be served best if they work solely through American firms already established in the Chinese field."

Because the Chinese are quick to observe and discuss things, judicious advertising meets with a quicker response in China than in many western countries. One American who reaped a rich harvest of orders after a good publicity campaign asserts that with sufficient advertising anything at all within reason in time can be sold profitably in China. In many cities motion pictures are very popular, attracting large crowds of the better classes. Slides advertising various articles are often displayed. The theater curtain is extensively used for bringing imported goods to the attention of Chinese audiences.

Probably the greatest field for immediate development in China is in the direction of communication and transportation. There are Chinese cities of more than 100,000 population without telephones or such facilities as water works or electric lights and street railways. In the central and northern section of the country there is a great need for new railroad facilities. Szechwan Province alone, as large as the State of Texas and having a population of more than 40,000,000, has the richest natural resources of any section of China, but it is almost isolated from the rest of the country because of the lack of rail communication. With four times as many people as the United States and an area about one-third greater, China has but 7,000 miles of railroads as compared with 240,000 in the United States. When adequate transportation facilities are provided, the internal development of China will be hastened and its foreign trade will comprise a much larger number of commodities.



American pickles and ship supplies on sale in Canton and Shanghai

Strength of the German Chemical Industry

REALIZING the difficulties of reconquering lost foreign markets after the war, seven leading chemical companies in Germany organized a combine in the autumn of 1915 to control output, secure uniform prices and wages, systematize production, and insure a harmonious policy for all other interests involved. In normal times German chemical exports averaged about $214,000,000 annually. When conditions permit their resumption they will be aided materially by the elimination of competition among producers and by their profitable operations during the war.

If the German press can be relied upon for accurate commercial and industrial information, the year 1917 was for the chemical industry in that country a period of intense activity and far-reaching achievement. All the concerns in the combine raised their capital, the total increase exceeding $40,000,000, and the net profits of six of them showed an aggregate gain of more than $10,000,000.

The American exporter has made tremendous strides in his sales of chemicals, drugs, dyes and medicines to world markets in the last five years, advancing from $26,800,000 in 1913 to $192,250,000 in 1917. In planning the extension of this trade after the war he must prepare to meet the highly organized competition of the German producers. The Webb Law, permitting combination in foreign commerce, gives the United States a powerful weapon with which to combat the German chemical merger. By taking advantage of this measure and by paying careful attention to merchandising and marketing we can continue our progress in chemical trade and make it difficult for Germany to regain its footing.

Iceland Buying More American Goods

OF the many countries that have increased their purchases from the United States since the beginning of the war, Iceland offers unusual interest because of the kind of merchandise we are sending to a market to which we have paid little attention in the past. Iceland and the Faroe Islands, which also belong to Denmark, imported more than $2,400,000 worth of American goods in 1917, a gain of nearly $2,000,000 over the previous year. Progress in road construction resulted in sales of American automobiles and accessories valued at more than $10,000, whereas until recent years transportation in Iceland was principally over bridle paths by horses. The southern coasts, washed by the Gulf Stream, enjoy a climate mild enough to justify a large use of cotton goods for clothing, over $25,000 worth being imported from the United States last year. American shoes have appeared in the market in considerable quantities; plate glass, phonographs, silverware, jewelry, laces, perfumeries, furs, and motion picture films are other articles that Iceland is now buying from us.

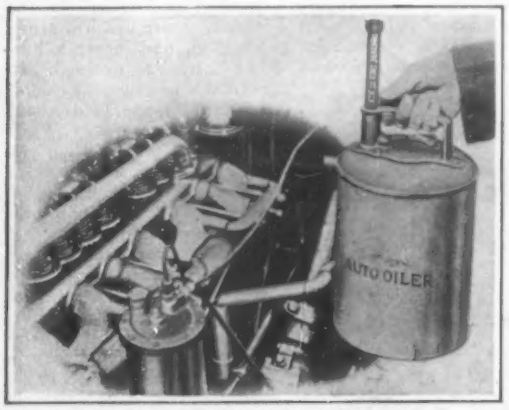
Most of this trade has come to the United States because Iceland's normal sources of supply, Denmark and Great Britain, have been unable under war conditions to send the kind of materials needed. Of course it is not probable that we shall retain anything like our present proportion of this trade after Denmark and Great Britain are in a position to supply it, but the larger number of American ships in the Atlantic service and the favor with which Iceland has received our goods will enable us to keep a fair part of it.

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

An Oil Can That is Different

THE careful automobilist has long been seeking a way of handling engine oils in a clean and accurate manner—something which would eliminate the dirty funnel and the dripping measure. There is no apparent reason why the last few drops of the fluid should always be deposited on the fender or the motor instead of in the reservoir, where they belong; but such has been the time-honored custom. This custom, however, is challenged by the very neat bit of apparatus which we illustrate herewith.



The dripless oiler, with long adjustable spout inserted in the oil opening of the engine

The general idea of this device is clear from the illustration. It may be said, however, that the indicator is very accurate, being operated by a compensating float which works equally well in any position. The amount of oil discharged is accurately recorded by a direct float gage operating within a graduated brass tube. The height of this tube is adjustable, and the gage record can be read from either side. Thus the car owner is assured a more positive measure than is possible with funnel and measure.

The long tubular spout can be turned down into any position necessary to enable it to be most conveniently inserted into the oil opening of the engine. On many engines this opening is so obstructed by the manifold or other attachments that it is very difficult to use the ordinary funnel. The adjustable spout illustrated gets completely away from this, and makes the most obstructed oil opening readily accessible.

The flow of oil is controlled by a thumb button on the handle of the can. Accordingly, there can be no accidental leakage during insertion or removal of the spout, for there is no flow during these operations. The spout can be turned down into the desired position and left in that position as long as may be necessary to get it properly inserted into the oil opening, and nothing will happen. It is not until the spout is fully in place that pressure of the thumb on the button releases the flow of oil and allows the proper quantity to be discharged. So with proper handling there can be no drip.

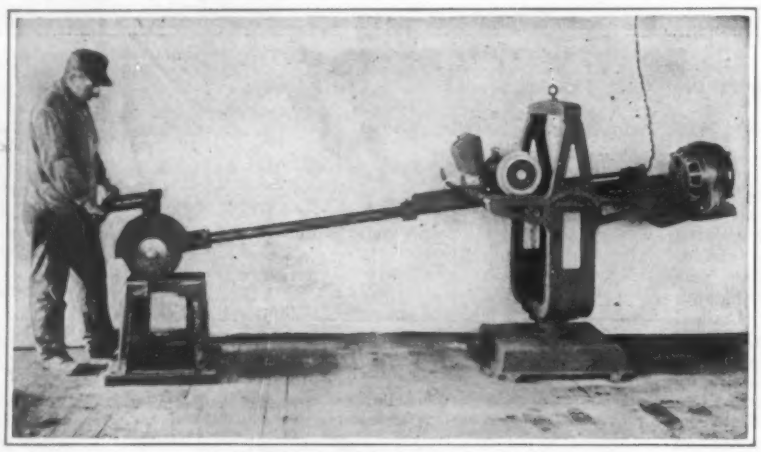
The Portable Electric Radial Grinder

THE accompanying illustration shows a unique portable electric radial grinder, developed at Hanover, Pa. This electric grinding wheel has a capacity 14 by 2 inches and it will be seen that the grinding head can be twisted completely around. The speed of wheel arbor is 1,350 r.p.m. and the motor is of 5 horsepower, operating at 1,800 r.p.m. The length of the arm from trolley to head is 7 feet, while the travel of trolley is 36 inches. The annular working area is 36 inches wide with a mean radius of 6 to 8 feet and the vertical movement of the head is down to the floor and upward to the height of a man. Its height over all is 5 feet and the length over all 10 feet, 4 inches, while the base area is 33 inches square. The net weight with the motor is 1,300 pounds.

It will be seen that this grinder is fully self-contained as it is mounted on a substantial base upon which it turns radially. The 5 horse-power motor is mounted on the platform at the rear and is coupled to a shaft running through the tubular arm to the wheel head, driving a set of 3- to 4-ratio steel bevel-gears which drives the wheel arbor. The steel bevel-gears are enclosed in an oil-tight gear-case which is packed with transmission grease. Ball bearings are employed exclusively in the head and in the trolley. The head comes to a poise when released by the workman, on account of the whole weight of the head and motor being below the center line of the trolley shaft.

It is pointed out that the machine can be carried with a crane and the trolley is held in a central position on the track by the lock pin which engages one of the trolley wheels. There are no moving parts exposed to the workman, everything being completely encased except the working half of the emery wheel. The motor controlling switch is usually placed close to the center of the machine near the trolley.

Another form of portable radial grinder designed for 18 by 3 inches and 20 by 3-inch wheel has been developed to turn completely around on its base. The head carried at the end of the radial arm can be twisted about 90 degrees in either direction. The head is counterbalanced by the weight of the motor which is mounted on a rearwardly extended platform or frame. At the sides of this platform are mounted two roller-bearing track wheels carrying the motor, arm and head back and forth on the track. There are racks provided at the side of the tracks which keep the track wheels in alignment on the track when the arm is turned radially. The motor is mounted on a sliding base by which the proper tension on the belt can be maintained. This machine is rigidly and durably constructed and the wheel arbor is mounted in phospor bronze bearings, with a safety shaped wheel, with safety flange collars.



A safe and convenient electric grinder

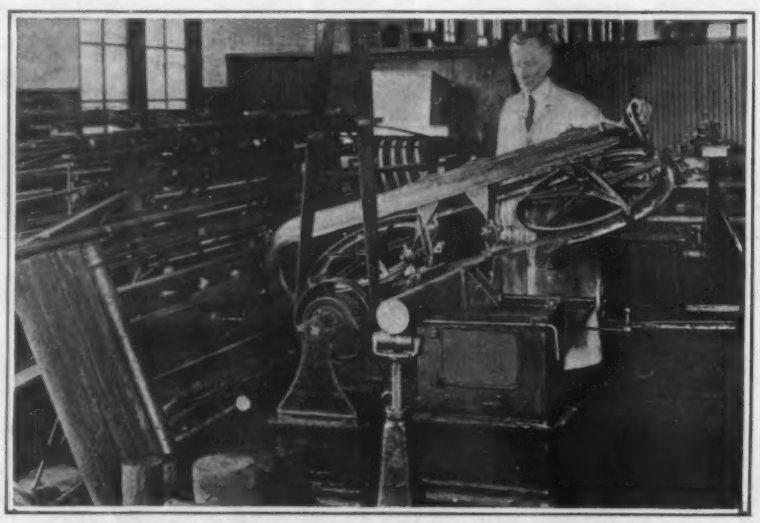
A Continuous-Stroke Hack Saw

THE accompanying illustration shows a novel band saw machine, developed at Springfield, Mass. This machine has been so designed that a continuous stroke hack saw has at last been realized. The band saw machine feeds into the work by gravity, due to the balanced weight of the tilting head. A spring at the back of the machine is in such a position and of such tension that the feeding weight is constant from the start to the finish of any cut which can be made on the machine.

The base is of cabinet type with lubricating tank enclosed. The bearings in the clutch pulley, and in the driving and idle wheels, which carry the tension of the saw, are heavy and rigid. The cutting band is lower than the returning band thus making it possible to cut off any length required. The cutting band is supported by truss arms, each carrying a pair of guides.

By means of the roll guides the band saw is directed so that its travel between the truss arms is absolutely vertical, thus assuring straight cutting. These guides once set are in perfect adjustment for any saw which may be placed on the machine. The teeth of the band saw are downward in the cut which insures that the cutting compound flows at once to the point of the saw tooth where it is needed.

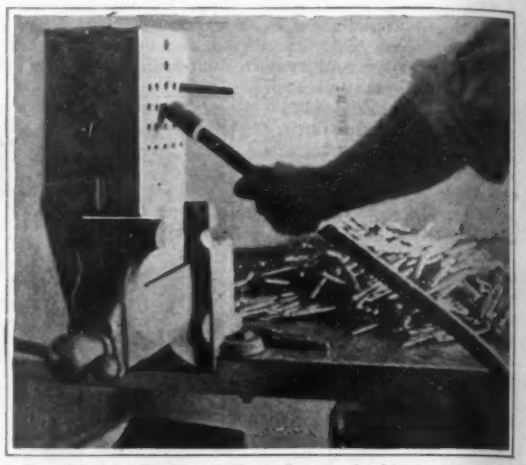
The speed in soft steel is 120 linear feet per minute of band saw, at 80 revolutions of driving pulley. In tool steel, the speed is 100 linear feet per minute of band saw with 70 revolutions of driving pulley, and in soft metals, 150 linear feet at 100 revolutions. The power required is one horse with a driving pulley 12 by 3, and geared four to one. The floor space required is 4 by 6 feet, and the height from floor to table is 26¾ inches, the length of band saw being about twelve feet. The net weight is 1,700 pounds.



The machine that affords a hack saw with continuous stroke

Safety Device for Breaking Hard Drills

A SIMPLE safety device has been developed by a large motor car company which protects the men who break up hard drills or other brittle or high-speed scrap metal. The high speed drills are made of two kinds of steel, high-speed for the lower portion and a softer grade for the shank. It is desirable to keep the two kinds of steel separate as the former is much more valuable than the latter. Breaking them by any other method is dangerous and slower. The device used consists of a box-like section with a front member of ¼-inch metal having holes of various diameters drilled in it as shown by the illustration. In use this section is placed in a vise and the drills which are to be broken put in the holes. When a piece of pipe is slipped over the projecting end and a slight pressure applied, the drill is broken, one half going down through the pipe and falling into a box or other receptacle at the operator's feet, while the other part is pulled through and dropped into another box. In this way, any likelihood of injury, due to flying bits of steel following the fracture, is found to be eliminated.



Breaking up high-speed steel scrap inside a pipe section, to guard agains flying chips

Grenades for American Grenadiers

HAND grenades of four types are now being produced at the rate of 2,000,000 a month, it is announced by the Ordnance Department. Within the next four months this rate will be doubled.

Rifle grenades are being produced at the rate of about 1,000,000 a month, and this rate will be multiplied appreciably within the next six months.

Orders have been placed for more than 60,000,000 rifle and hand grenades, and more than 18,000 persons are employed in plants throughout the country engaged in making them.

Based on the method of firing there are two general classes of grenades, namely, hand and rifle. The hand grenade may be of the defensive, the offensive or of the chemical type, of which latter there are two classes, phosphorus and gas.

The defensive grenade is the most powerful and the one generally used when tactical conditions permit, being thrown from cover at an advancing foe. It is about the same size and shape as a very large lemon with a body or shell of grey cast iron scored with deep grooves longitudinally and transversely to insure proper fragmentation when it explodes.

In addition to the body, the main parts of the grenade are: the *bouchon* assembly, detonator and explosive mixture.

The *bouchon* is a die-casting, composed of a tube which is screwed into the end of the grenade body, and a projecting head. The tube holds a standard fuse and detonator which are inserted into the lower (inside) end, so as to bring the primed end of the fuse flush with the upper end of the tube. The projecting head consists of a cylindrical seat with four small lugs on the inside, which hold the priming cap in place over the primed end of the fuse, and a casing which contains the firing spring and the striker. These last are hinged on a pin inserted through two holes cast in the sides of the casing, and are so placed that the spring, when released will drive the striker against the primer.

The spring and striker are kept cocked by an operating lever, which hooks over the side of the casing opposite that through which the hinge-pin is inserted. This lever caps the casing, and extends down along the outside of the grenade body. It is held in place by a safety pin with a ring attached to it, which passes

(*Continued on page 348*)

...and with Navy Officers, it's a little over 80%

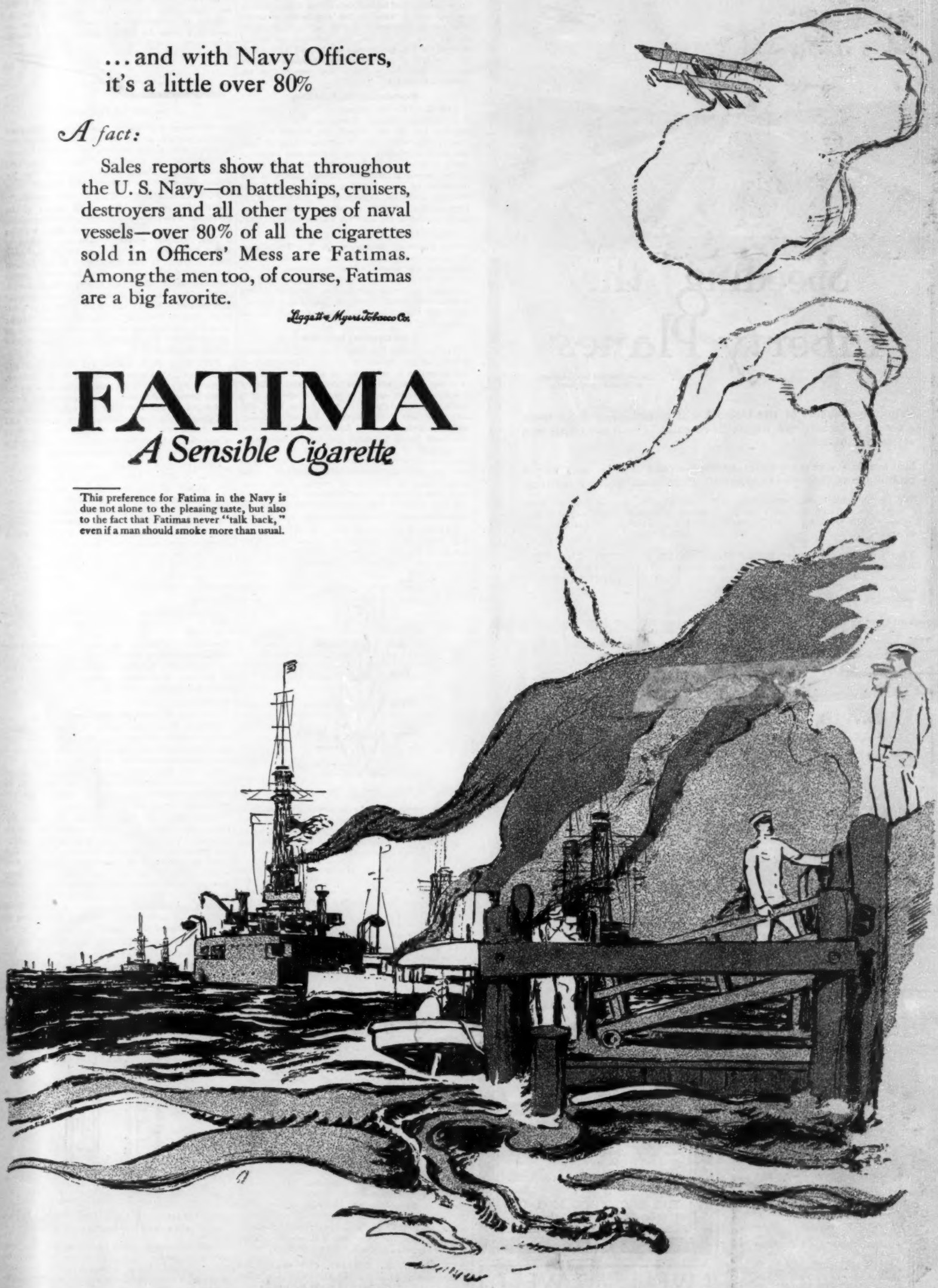
A fact:

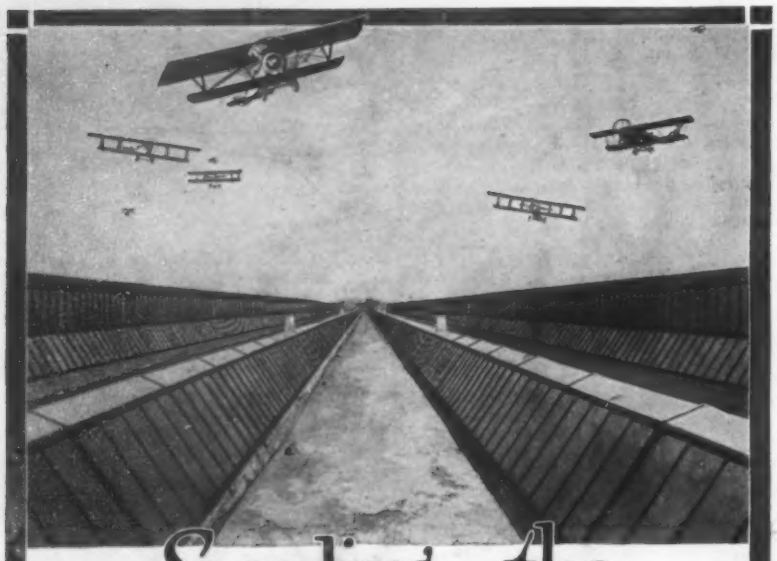
Sales reports show that throughout the U. S. Navy—on battleships, cruisers, destroyers and all other types of naval vessels—over 80% of all the cigarettes sold in Officers' Mess are Fatimas. Among the men too, of course, Fatimas are a big favorite.

Liggett & Myers Tobacco Co.

FATIMA
A Sensible Cigarette

This preference for Fatima in the Navy is due not alone to the pleasing taste, but also to the fact that Fatimas never "talk back," even if a man should smoke more than usual.





Speeding the Liberty Planes

Roof of Delco Light factory, now used by Dayton-Wright Airplane Co.

When the makers of the Delco Light consulted us about their great new factory we might have said, "Use a sawtooth or a series of monitors."

But we knew that no ordinary roof would ventilate so wide a building; also that a wide sawtooth gives unsatisfactory lighting.

We recommended the Pond Truss roof here shown. It was cheaper than a sawtooth. It required less sash. It gives abundant, ideally-distributed light—"like working under a tree." And it gives *real* ventilation, rain or shine.

That factory is now used by the Dayton-Wright Airplane Company. They have other buildings; but all the most responsible Wright product is made under Pond Trusses, protected with top-hung, motor-operated Pond Continuous Sash.

The Pond Truss was invented to aid our customers to get 100 per cent service from Pond Continuous Sash. It has set a new standard for lighting and ventilating performance in nearly a hundred buildings.

Ask our Service Department.

POND CONTINUOUS SASH

is made in 20 ft. units, joined by expansion caps into lines of any length. It is top-hung, with storm panels at the ends, hence excludes any ordinary rain. Exclusive patented features give unusual strength and resistance to corrosion.

DAVID LUPTON'S SONS COMPANY

Clearfield and Weikel Sts. Philadelphia, Pa.

Makers of modern equipment for daylighting and natural ventilation.

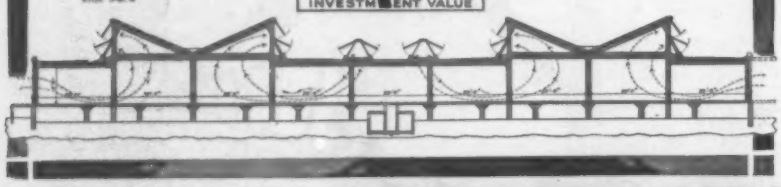
Lupton Steel Sash
Pivoted Factory Type
Counterbalanced Type

Pond Continuous Sash
for sawtooths, monitors and side walls

Lupton
INVESTMENT VALUE

Pond Operating Device
for long lines of sash

Lupton Rolled Steel Skylight



BESSEMER
OIL ENGINES

COAL is scarce, electric power often inadequate to meet requirements. Only fuel oil is plentiful and comparatively cheap. That is why Bessemer Oil Engines so admirably answer the need of the hour for operating economy. Burning cheap fuel oil, they produce maximum power at minimum cost. 15 H. P. to 180 H. P.

Write for catalog.

THE BESSEMER GAS ENGINE CO.
14 York Street, Grove City, Pa.

Rockwood Friction Transmission

Will do more to eliminate the waste of power in machinery involving power transmission than any other mechanical device. This is especially true where quick starts and sudden stops are necessary. Some place in your plant or product there may be a place where Rockwood Friction Transmission will save you time and money. Investigate it. Send for our 92 page book "Friction Transmission." It is of great value to manufacturers, designers, and engineers. Please mention firm connection.

THE ROCKWOOD MFG. CO.
1904 English Ave. Indianapolis, Ind.

WELL DRILLING PAYS WELL

Own a machine of your own. Cash or easy terms. Many styles and sizes for all purposes
Write for Circular.

WILLIAMS BROS., 434 W. State St., Ithaca, N.Y.

RECENTLY PATENTED INVENTIONS

Pertaining to Apparel

HOSE SUPPORTER.—H. SCHOTTENFELS, 59 W. 92d St., New York, N. Y. A specific object of the invention is the provision of hose supporter embodying a pad having depending hose-engaging means, and a band or leg embracing element. The device comprises a pair of tapes fastened at one end to the pad and adapted to extend around the leg, and means on the pad with which the free end of one of the tapes engages the free ends of both tapes being tied together in leg embracing position.

Pertaining to Aviation

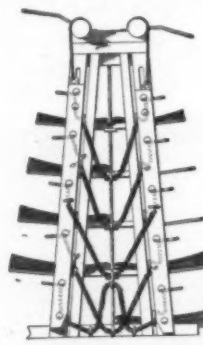
AIRPLANE.—N. CAROLIN, S. C. Aviation Experimental Station, Hampton, Va. This invention has for an object the provision of a construction which may be adjusted so as to vary the head resistance, lifting planes and associate parts, so as to change the machine into high speed or low speed at will. A further object is the provision of the extending of the rear of the fuselage and the expanding or contracting of wing surface without molesting or changing the usual control of the ailerons, rudder and elevator.

TURNBUCKLE.—A. P. KIRCHHUBER, 1195 Ocean Parkway, Brooklyn, N. Y. The object of this invention is to provide a turnbuckle for adjusting the tension of stays, braces, links or similar devices made of wire cable, as used on airplanes and other structures. Another object is to provide simple means for quickly and securely attaching the ends of the stay or brace to the turnbuckle.

Of General Interest

ALUMINUM SOLDER.—D. M. CAMPBELL, 916 E. 32 St., Brooklyn, N. Y. The object of the invention is to provide an alloy in the shape of a bar which will solder aluminum articles by a soldering iron or braze them by means of a torch. It is produced in two forms hard and soft, the soft being applied by an ordinary soldering iron, the hard by firing with a torch, the hard being intended for heavy aluminum or castings of aluminum, the soft for light or heavy material; the solder gives a smooth finish and has the appearance of aluminum. This solder alloy is formed of copper, aluminum, lead, tin, and zinc. The difference between the soft and hard is only in the proportion of the ingredients used in making the alloy.

PAPER BAG FOLDER.—W. D. ELLIOT, 2nd Ave., West, Bigtimber, Montana. This invention has for its object to provide a device, wherein the bags may be supported in bundle



A SIDE VIEW OF THE HOLDER

relation, each size in a separate compartment, and wherein the packages are yieldingly held, and the holding means for the packages being provided with a common means for releasing the same to permit insertion of the bags.

SHOE RACK.—R. IMBRIANI, 472 Grand Ave., Brooklyn, N. Y. The invention relates to shoe racks designed to be used in shoe factories and to be moved from place to place during the manufacture of shoes; it has for an object the provision of an improved construction which will properly hold the shoes ready for the workman while providing a safe container after the day's work is over. The rack is fireproof and may be sealed against the entrance of dust and rodents.

WATER CLOSET.—F. SCHUH, 414 Rutherford Ave., Trenton, N. J. The object of the invention is to provide a water closet arranged to occupy a small amount of space, to insure thorough flushing of the bowl, and to allow use of the water closet with a high or low pressure water supply. Another object is to facilitate the siphoning action of the bowl and provide a relief valve in the tank to insure complete discharge of all the water in the lower portion of the tank and conduct such water into the bowl.

WATERPROOF STORM SHIELD.—J. A. GAVIN, care of L. C. Smith Co., 217 Broadway, New York, N. Y. Among the objects of the invention is to provide a storm shield made of a material adapting it to be folded into a compact package suitable to be dispensed through coin controlled machines or to be carried in one's pocket or shopping bag. Another object is to provide a shield in the nature of a cape or umbrella, made principally of a waterproof material such as paper, but of a nature cheap enough for it to be sold on the market for a few cents.

DESK.—W. E. BURGETT, care of Citizens State Bank, Flaxton, N. D. The invention relates more particularly to desks for use at outdoor auction sales, the object is to provide a portabe means whereby an accurate record of each sale may be made. A further object is to provide means whereby the individual records, in the form of sales checks, may be instantly accessible whereby purchase money may be received into the device and any change returned, and whereby moneys so received are kept inaccessible to anyone other than the person carrying the device.

SHOVEL.—DE WITT M. COINER, 530 Stadd St., Statesville, N. C. The object of the invention is to provide a shovel which may be used as a sifter for sifting ashes, or as a shovel

A SECTION OF THE DEVICE

for shoveling any desired material, it comprises a scoop portion, and a handle, the scoop portion having a wire screen bottom, and a false bottom for covering the screen, the false bottom comprising a plate fitting within the scoop over the screen, the scoop has the usual side flanges.

FUEL BRIQUET.—W. KENNETT and E. T. KREBS, Carson City, Nev. An object of the invention is to provide a briquet, the composition of which is mainly oil shale; oil shale used as a fuel, without special treatment, instead of being reduced to an ash remains in the same form in which it was introduced in the furnace and soon tends to clog up the latter, unless removed bodily. A further object of the invention is to reduce the oil shale to a coarse powder and then bind this powder with a liquid or semi-liquid binder, forming a briquet which permits of great combustion of its carbon contents, at the same time will disintegrate so that it may be readily removed.

PITCHER FOR CANS OF CONDENSED MILK.—C. C. FELTNER care of F. B. Feltner, Hazard, Ky. The invention relates to a pitcher which forms a container or receptacle for a can of condensed milk, so that the contents can be dispensed from the container in a sanitary and economical way without exposing the contents of the can to the direct action of the atmosphere when not delivering the contents from the can.

CHRISTMAS TREE HOLDER.—J. G. LYONS, 74 Elliot Ave., Maspeth, L. I., N. Y. The object of this invention is to provide a foldable holder or stand in which the gripping members are pivoted to the outer ends of pivotally connected crossing bars which maintain a permanent size supporting base, and another pair of pivotally connected cross bars above the first are linked to the free gripping members, whereby the weight of the tree on the second-mentioned bars causes the upper ends of the gripping members to swing inwardly and hold the trunk of the tree.

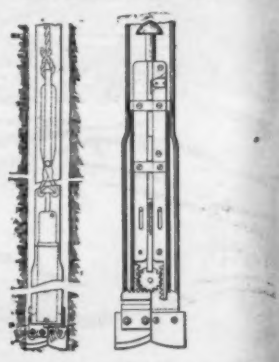
ARCH SUPPORT.—W. S. PHELPS, 142 E. 30th St., Portland, Oregon. The object of the invention is to provide an arch support for insertion in a shoe, the support having horizontally extending pockets with openings through which pads may be inserted to correct the position of the foot, and thereby relieve the foot from abnormal strains and assist in remedying ailments.

Hardware and Tools

SPIKE MAKING DEVICE.—W. O. FRAGMEIER and O. G. MUHLIG, Portland, Ore. The invention has for its object to provide a device of the character specified by means of which two spikes may have their points simultaneously cut and pointed, without leaving any flare, fin or other superfluous material, and wherein the two spikes may be formed at once.

REAMER.—O. EBERT, 1392 E. 34th St., Cleveland, Ohio. The prime object of the invention is to provide means to adjustably secure the cutters in the head of the tool. In the tool head is produced diametrically opposite slots which slidably receive the cutters, the slots meeting at the center and constituting in effect a single through slot. At the sides of the slots grooves are formed which receive a guide rib on the back of each cutter, the ribs thus being at opposite sides of the cutters.

EXPANSIVE AND CONTRACTIVE WELL DRILL.—O. M. CARTER, Houston, Texas. An object of this invention is to provide a drill including as the essential feature a carrier casing having the expansive and contractive drill bits mounted



SIDE ELEVATION SHOWING DRILL IN THE DRILL STEM, AND A VERTICAL SECTION

therein with rack plates for extending the bits, the casing being adapted to be lowered into the drill stem and also to be raised out of operative position, without involving the danger of scarifying the well bore.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of patentee title of the invention, and date of this paper.

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Because of cranes such as this and the thousands of others of various types in mill, shipyard, foundry and shop, coal and ore can be moved in greater volume, the manufacture of iron and steel accelerated, the factory speeded to greater production. There is hardly an industry of importance that is not made more efficient and more productive because of the electric crane.

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UNITED STATES FUEL ADMINISTRATION
BUREAU OF CONSERVATION
WASHINGTON, D. C.

July 5, 1918.

Mr. C. J. Stover, Secretary,
Insulating Materials Trade Associations,
Bulletin Bldg.,
Philadelphia, Pa.

Dear Sir:

I wish to thank your Associations for their most cordial offer of cooperation with this Administration in its conservation work. The utmost economy and efficiency by all consumers in the use of coal and fuel oil is absolutely necessary if the country is to maintain its war activities at top speed throughout the struggle and we must find means of stopping the many and large preventable losses in the burning of these fuels.

The Fuel Administration realizes that bare piping is one of the most easily preventable causes of these losses and that adequate insulating covering for them is essential to the conservation of our all too scant fuel production. We are asking that all consumers, both domestic and industrial, provide sufficient insulation for exposed hot surfaces and we feel that it is the duty of every one to see that this request is carried out to the fullest possible extent.

The most effective means of cooperation by your Associations is for them to bring this message home to the coal consumers of the country. That will be a real and important service toward the winning of this war.

Very truly yours,

UNITED STATES FUEL ADMINISTRATION

H. A. Garfield
Director of Conservation.

The Answer is —

It is imperative that you do not neglect this important question of Fuel Saving. The fullest available information will be gladly placed at your service by this Association. Submit us your problems or write us for the illuminating treatise on Heat-Saving, entitled "Let '85% Magnesia' Defend Your Steam."

To Engineers and Architects, a copy of the new specification of the Magnesia Association, compiled and endorsed by the Mellon Institute of Industrial Research, will also be sent free, on request.

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To Keep the Automobile Engine from Stalling

(*Continued from page 332*)

crankshaft, between the crankshaft and the flywheel. This ring is insulated from the shaft by the thin collar beneath it, shown black, but is attached rigidly, so that it revolves with the shaft. The current is collected from the rotating ring by a brush, which is attached to the crankcase by an insulating bracket, but makes contact with the surface of the ring. From this brush the "juice" is conveyed, through the switch that governs the ignition, to the magnet *C* and finally back to the battery.

The contacts *A* and *B* are normally held together by a spring in the base of their V-shaped mounting, so the circuit is broken only at the switch. When this is closed, throwing the ignition into operation, the engine starts and the flywheel begins to revolve. Assuming the clutch to be out, the speed rapidly becomes such that centrifugal force, acting upon *B*, overcomes the spring and throws *B* out of contact with *A*. This breaks the circuit, a necessary preliminary to running the car.

The clutch is now thrown in, as usual, by the pedal, and the car picks up. Presently it strikes a hill, or some other impediment that results in overloading the engine. The flywheel slows down, and in the absence of the regulating circuit would stop altogether, stalling the engine. But with the regulator, as soon as the flywheel speed falls sufficiently to make the centrifugal pull upon *B* less than the pull of the spring, *B* snaps down against *A*, and the regulating circuit is closed.

The magnet *C* is energized, and the armature is pulled over, the magnetic force overcoming the tension of the spring which normally holds it back. This motion is communicated to the valve *D*, which opens, allowing compressed air to flow from the tank to the piston chamber *E*. The piston and connecting rod are forced back, and the clutch disengaged. The engine, relieved of its load, at once gathers speed; and as soon as it is going fast enough to take up again the labor of running the car, the contact *B* breaks away under the centrifugal pull. The circuit thus broken, the magnet is de-energized, the armature springs away, the valve is closed, and the flow of air cut off. The clutch then slips slowly back into place as the compressed air escapes through the ports in the chamberhead, which may conform, in size and number, with the requirements of the particular case.

Since the circuit is broken when the engine is not running, the compressed air is not then flowing. As soon as the ignition is switched in, the circuit is made and the air begins to flow. The clutch is out, so there is no action against the engine; a head of air accumulates in the chamber, and that is all. This head does not become excessive, since the flow is cut off as soon as the flywheel attains good speed; but it is sufficient to insure that the clutch is not thrown in too suddenly, so here is another advantage.

As a final feature, the rod connecting the air-piston with the clutch is at the same time operatively connected with the throttle that regulates the fuel supply. Operation of the regulator therefore not only relieves the engine of the overload that caused all the trouble, but the fuel supply is also temporarily accelerated, so that the desired engine pick-up is more quickly attained. By the breaking of the circuit at *A-B*, this is restored to normal at the proper moment. The engine then proceeds to drive the car in regular order again, and, as a side issue, to recharge the air cylinder against the next emergency.

Anti-U-Boat Operations of the French Navy

(*Continued from page 333*)

sinkings by torpedo and gun-attack diminished perceptibly. Instead of venturing through the submarine zone singly and at frequent intervals, all merchant vessels, no matter what their nationality or their destination, were obliged to sail in company under heavy escort, and compelled to make their voyages according to schedules dictated by the naval authorities. Occasionally a cargo ship was lost, but this soon became the exception rather than the rule, as an examination of the official statements for 1916, 1917 and 1918, show.

The organization of the numerous ocean and coastal convoys coincided with the appearance in French waters of a large number of motor-driven submarine chasers, built in the United States for the French navy. These vessels, embody all the desired characteristics of high speed and seagoing qualities, and they have proved ideal "vedettes de patrouilles" for the coastal work on which they are employed.

Mention should also be made of another type of anti-submarine craft, which in its design and construction is wholly Gallic. This is the "aviso," which has its counterpart in the British "sloop." In the "aviso," the French naval constructors have developed a motor-driven, ocean-going cruiser, which exceptionally well embodies all the characteristics considered essential to offensive anti-U-boat operations, namely, high speed, heavy armament, high freeboard, excellent sea-keeping qualities, and a maximum steaming radius. The machinery of the "avisos" may be said to be a product of the war, and it is mainly due to its excellence that these vessels have proved so satisfactory under all conditions of service.

Before the war, it was thought hardly possible that submarines could ever be used to combat hostile undersea-craft. The events of the past few years, however, have demonstrated that the submarine, under certain conditions, is the ideal type of vessel for meeting the enemy's U-boats on their own terms. We have often heard the old saying: "Set a thief to catch a thief." Well, the Germans made the French realize that it sometimes takes a submarine to catch a submarine. As a French submarine commander summed up the situation: "The U-boats used to enjoy the advantage of remaining themselves invisible, while all the surface and aerial craft which were sent in pursuit of them were boldly outlined against the sky and visible to them. This is one of the reasons why we are now using our submarines to ambush their U-boats. We have been quite successful, and we shall continue to pay them back in their own coin. And that is a great deal, when you consider how ill equipped we were for this work when the Boches sprung their U-boat campaign on us."

Strategic Moves of the War

(*Continued from page 334*)

civilized manner. This has also ended the German dream of the control of the Mahometan world through influence in Constantinople. The Berlin-Bagdad railway was to give this control in the Turkish Empire and was to be the means of transporting armies led by German officers to Egypt and India. But that dream has all been dissipated by the defeats in Palestine and by the collapse as an ally of Bulgaria; the latter fact practically separates Germany and Turkey so that hereafter Turkey will be dealt with alone. It will not, therefore, be as easy for Turkey to make peace as it was for Bulgaria, because the latter will remain as a kingdom or unified government while Turkey can hope to reserve little of her great eastern empire and may even soon be ousted from Constantinople and sent to Asia Minor with Broussa as a capital. The way of the transgressor is hard; Turkey is now reaping the reward of her centuries of cruelty and rapine practiced upon defenseless peoples.

After a parley of two or three days Bulgaria finally quit the Central Alliance on October 1st, thus breaking up over night the German plans of conquest and empire in eastern Europe and western Asia. All the Bulgarian railroads passed at once into the hands of the Entente Allies so that, when necessary, troops can be transported to Adrianople, thus driving at the Turkish capital from the rear. The Allies are reaping to the full the benefit of the Bulgarian collapse, for the Serbian forces are advancing rapidly into their own country and overcoming the resistance of Austro-German troops of whom there are still quite a large number in Bulgaria and Serbia. These are trying to assemble along the railroad leading from Belgrade to Nish and Sofia; those already on the railroad endeavored to assemble at Nish but the Serbs and French reached that place ahead of them. The town is one of the most important railroad centers on the only direct route between Berlin and Constantinople; its capture is, therefore, of great importance to the Allies. The only other route now available to the Central Powers is across the Black Sea, either through Rumania via Constanza or through Russia via Odessa. No doubt much of the rolling stock of the railroad has been run back into Austria so that some time will be necessary before the Serbs and French can use the road to advantage. Reports indicate that the Austrians are even withdrawing from Belgrade and establishing their forces on their old lines on the north bank of the Danube River.

In Albania, the Austrians, threatened as they are from the east, south and west, are retiring toward Montenegro with every prospect of having to surrender before they can reach Austrian territory. The collapse of Bulgaria has thus opened a new route for an attack by the Entente on the forces of the Austrian Empire. After the Serbians shall have freed their own country, no doubt they will endeavor to invade Bosnia and Herzegovina, peopled almost exclusively by Slavs, and in full sympathy with Serbian aims. An invasion from this quarter would probably be the beginning of the end for Austria as she can hardly defend herself against an attack from this unexpected quarter. There would, under such circumstances, be every reason to expect a body blow on this vulnerable front that would topple over the crumbling power of the Hapsburg empire, thus leaving Germany alone to face her foes in a frantic effort to put off the inevitable hour of absolute defeat. There is every indica-

(*Continued on page 346*)

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THE SCHWERDTLE STAMP CO.
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Strategic Moves of the War

(Continued from page 344)

tion that Turkey will very shortly follow Bulgaria in arranging an armistice or separate peace, thus leaving Austria and Germany in the lurch. No doubt the same demand will be made upon her as upon Bulgaria, to demobilize her army and surrender her fleet, in which case a large part of the Entente Allied armies could be transferred from Syria and Mesopotamia for service in Europe. Rumania would again have an opportunity to throw off German rule, mobilize her army, and re-enter the struggle as she could furnish at least five hundred thousand men for that purpose. Again Austria would be threatened with invasion from that quarter by a force far larger than any that she could assemble to resist; with the menace from Serbia, the constant threat of invasion from Italy, and with Germany unable to send assistance, there will be nothing left but to surrender at discretion.

The Kaiser's dream of a German controlled empire has been most rudely shattered for his Mittel-Europa scheme that, only a short time ago, extended to the Tigris and the borders of Palestine, may soon be driven back beyond the Danube and the mountains of Rumania. The Bulgarian fiasco will force the surrender of Turkey and the latter event will break down the Austro-Hungarian resistance, because the elimination of Turkey will open a road through to Constanza and Rumania and the Austro-Germans now in Serbia must go back eventually beyond the Danube. The opening of the Dardanelles will render possible the use of Odessa as a base for operations in Russia. The great inconvenience that has hampered the Allies being dependent upon Vladivostok and Archangel will be removed when Russia can be reached from the south. At present their position, even under existing conditions, is not unfavorable, as their forces that were landed at Vladivostok now control the Trans-Siberian railroad as far west as Lake Baikal. Beyond that lake and the Ural mountains, the Czeche-Slovaks are supreme and they even control the railroad as far as Samara and Kazan on the Volga. They are experiencing some opposition from the Bolsheviki; but so far they have been able to hold their own even though scattered over an immense territory. Between the lower Volga River and the mountains of the Caucasus the Cossacks are in power as opposed to the Bolsheviki. But all of Russia west of the Volga is controlled by the latter and by the Germans, except the Murmansk coast and the country around Archangel on the White Sea. The Germans themselves control Finland and western Russia to the Black Sea but present conditions on the western front and the line of the Danube have rendered it necessary to withdraw many troops; consequently they are not able to maintain sufficient forces in the country to make certain their mastery. As a result their tenure here is very uncertain; in case of the success of the Entente Allies, they will be forced to give up entirely their conquered Russian provinces. The outlook for any permanent advantage for all their efforts in Russia is slim and their hold in that country promises to be short-lived.

The Current Supplement

FEW people realize the multitude of trials that fall to the lot of the soldiers in active service, and the ideas derived from an inspection of one of our training camps altogether fail to depict conditions as they actually exist at the front. Not only do our boys have to endure the inconvenience incident to an extremely nomadic manner of living, but there are many additional and special discomforts that test their endurance to the utmost. One of these is the swarms of rats that infest every place where troops tarry for any length of time, no matter how remote from other human habitations. This is so serious that it has been made the subject of scientific investigation by the French authorities, and some of their findings will be found in a paper on *The Invasion of the Trenches by Rats* in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2234, for October 26th. Another paper of considerable importance in many directions deals with *The High-Speed Internal Combustion Engine*. Curiosity has been a characteristic of mankind in all ages and in all countries, and manifests itself in many ways. An article on *Gazebos* tells how it appears in architecture, in structures whose significance is not generally recognized in these times. A number of illustrations show various examples of these observation posts. *Oxyliquite* is a liquid oxygen explosive, which apparently has many applications in every-day-life. Something of its nature, with illustrations explaining how it is used is told in this issue. The paper on *How Things Break*, accompanied by many additional illustrations is concluded. Other articles of importance include *Metals Used in Aeroplanes; The Use of Creosoted Fir for Marine Construction; Evolution and Destruction of Life, Substitutes for Glass*, and *Scent Producing Organs of Insects*.

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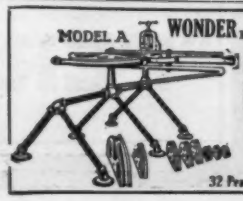

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(*Continued from page 340*)

through the sides of the casing. The small opening underneath the operating lever is closed by a sheet metal sealer.

The grenade is safe till the operating lever is released. Even after the safety pin is removed, the grenade cannot function as long as the lever is held against the the body of the grenade by the hand of the thrower. In other words, the firing-spring cannot operate until the grenade is thrown. The normal time for the burning of the fuse (that is, the time which elapses between the throwing of the grenade and its explosion), is five seconds.

When a soldier is ready to throw the grenade, he grasps it firmly in his right hand, removes the safety pin, holding the lever against the grenade body, assumes a position similar to an athlete "putting the shot," and throws at the objective with a straight-arm, overhand throw. When the grenade leaves the hand, the lever flies up, and the striker spring is released, driving the striker against the primer which ignites the fuse. At the end of the five-second period, the grenade explodes, providing some 300 fragments, effective at from 60 to 70 feet.

The offensive grenade differs from the defensive in that it depends entirely upon its explosive effect for its usefulness against the enemy and is generally used at shorter range, in offensive tactics, and when the grenadier is not necessarily under cover. The body is composed of a cylinder of waterproofed cartridge paper, with a conical die-cast top, threaded to receive a *bouchon* and operating lever, precisely like those of the defensive grenade. The fuse and detonator, and method of operation are exactly similar to the other type.

The phosphorus grenade has a barrel-shaped container of drawn sheet steel, about 3½ inches long and 2¼ inches in diameter; to one end of this body is welded a steel collar or bushing, threaded on the inside. Into this collar is screwed a steel thimble which runs down into the center of the inside of the body of the grenade; this thimble is designed to prevent the phosphorus charge from coming into contact with the detonator and fuse. These last, together with the standard *bouchon* assembly of which they form a part, are screwed into the top of the thimble, which is threaded on the inside for this purpose. The grenade is painted gray when loaded (live).

The phosphorus grenade furnishes a shower of burning fragments of phosphorus as well as a cloud of dense white smoke, which can be used to repel an advancing attack, or if thrown during an advance, would both furnish a screen to conceal the advance and repel any enemy parties that might be in the open.

The gas grenade is in construction similar to the phosphorus grenade, save for two annular corrugations about a quarter of an inch apart on the body, near the bottom, to serve as a distinguishing mark.

It produces a low-lying cloud of dense white gas of an intensely irritating nature which may be classed as suffocating gas.

It is used largely in what might be termed "mopping-up" the trench, cleaning out dug-outs by forcing the enemy into the open, or forcing him to wear a gas mask during the advance.

Rifle grenades are used to fill in the gap between the hand grenade and the light trench mortar. The type used by our Army was designed by two Frenchmen, Vivens and Bessieres, and in their honor is called the V. B. rifle grenade. It is about 2½ inches long, 2 inches in diameter and is fired from the discharger which fits over and is attached to the muzzle of the rifle in the same manner as a bayonet.

The body of the grenade is a cylindrical iron casting with a rounded top and a flat base, perfectly smooth on the outside, and fitting closely into the discharger, but scored with deep grooves on the inside, to ensure proper fragmentation. It is pierced longitudinally by a central tube, through which the bullet from the rifle cartridge passes.

The firing mechanism comprises a brass fuse container and a detonator tube, the former fitting into the end of the latter. These are inserted, respectively, into holes precisely opposite one another in the top and base of the grenade body, and so placed that the axis of both runs parallel to and about half an inch distant from that of the central tube. The head of the fuse-container projects beyond the rounded top of the grenade body, and its inner face is fitted with a primer beyond which a striker projects obliquely over the end of the central bullet tube. When the bullet from the rifle cartridge has passed through the central tube, it hits this striker and thus fires the primer; from the primer, the flash is transmitted to the fuse, which runs longitudinally through the center of the fuse container into the interior of the grenade, and is timed to burn eight seconds. The fuse in turn fires the detonator, which bursts the walls of the detonator tube, and fires the main charge, thus exploding the body of the grenade.

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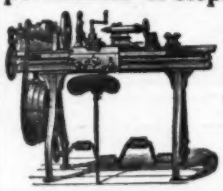

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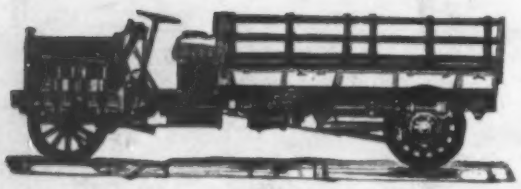

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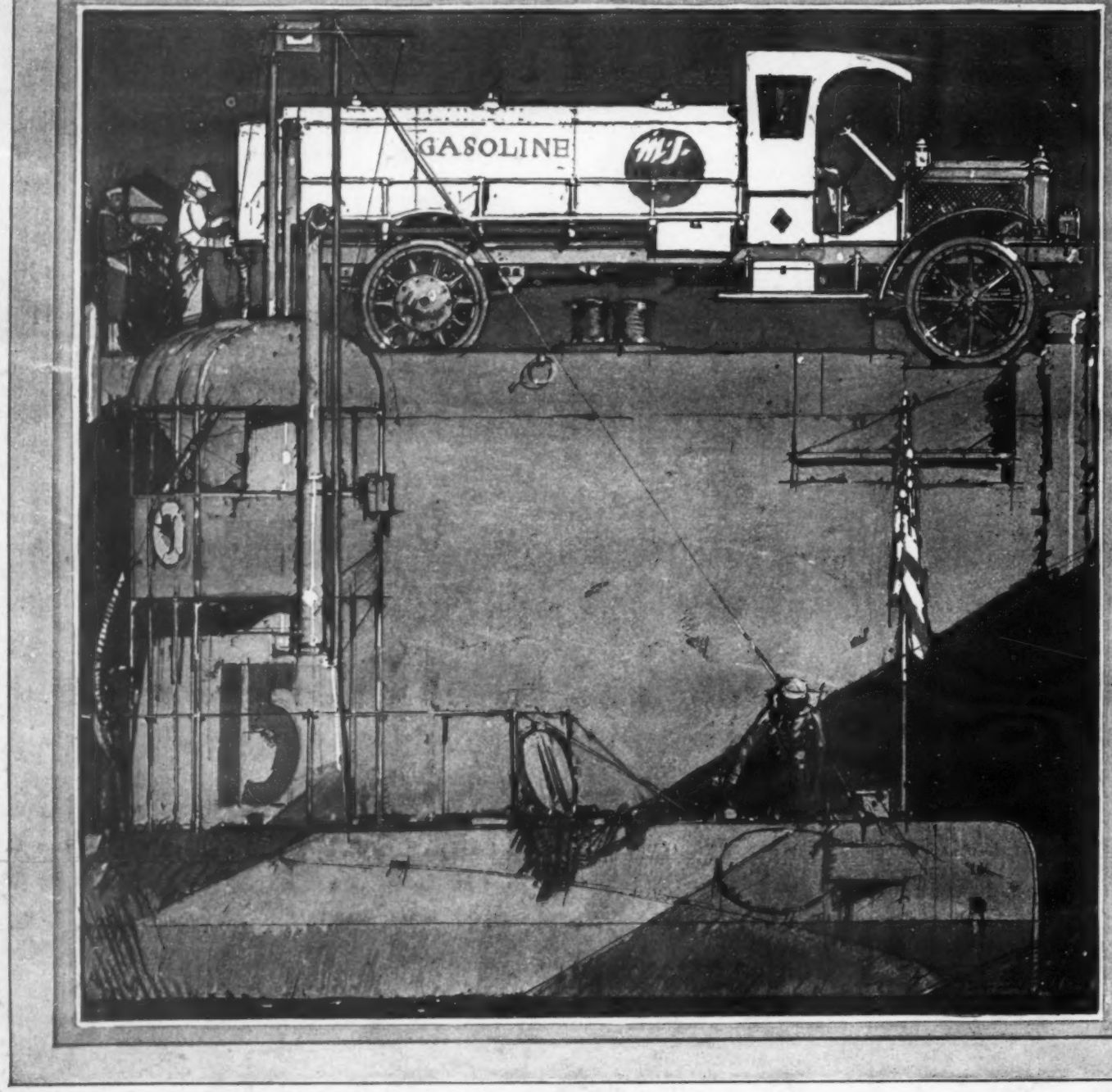

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